

2 Special Pullouts Inside

1997 PC Buyers' Guide

Guide to Online Search Services

NETWORK EDITION

Intelligent RAID:
4 Subsystems to
Guard Your Data



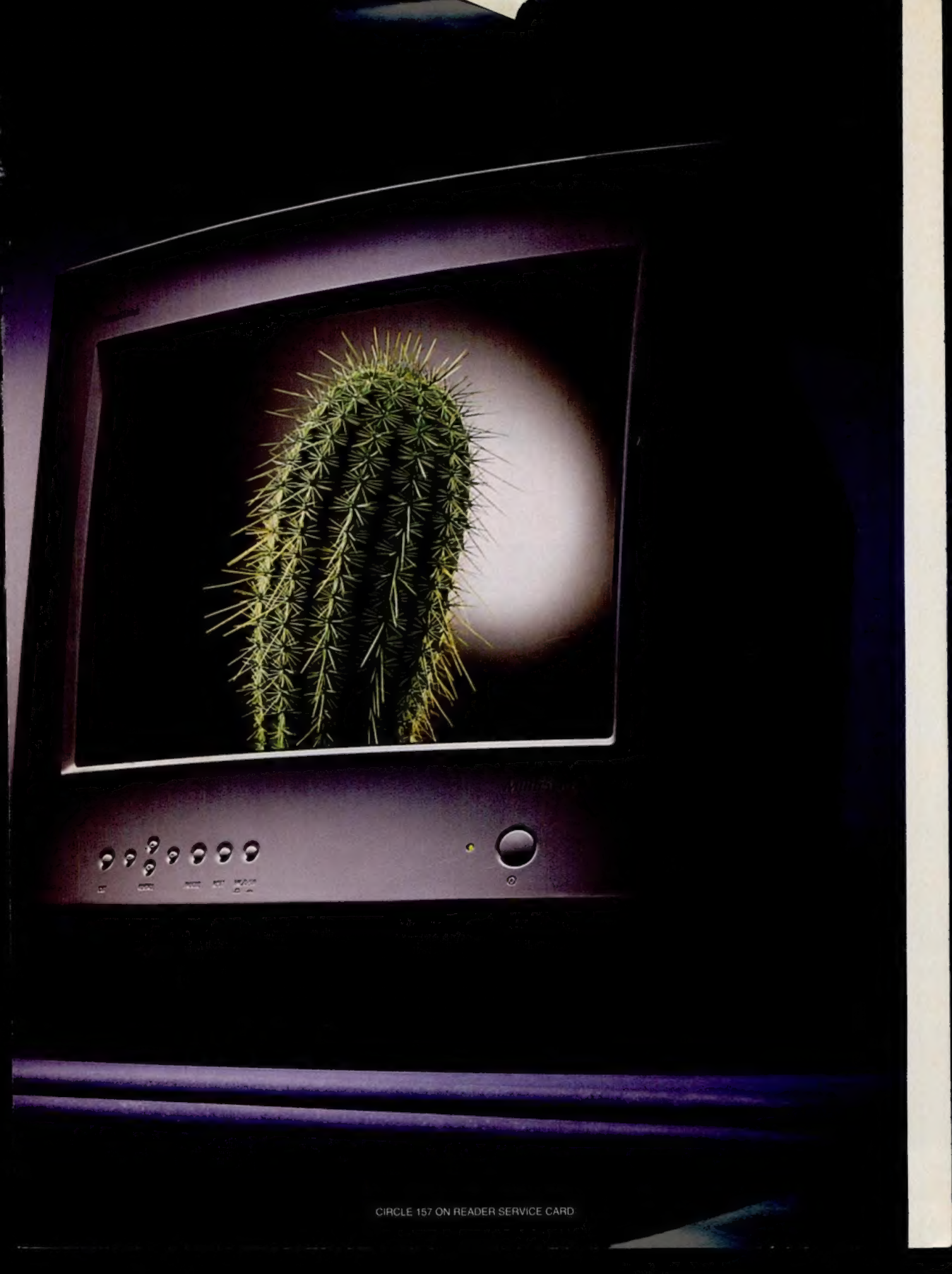
FAST AND FASTER

PC Labs Tests 91 Speedy Contenders

Pentium- and Cyrix-
Based Machines That
Provide Top Speed
For Your Applications



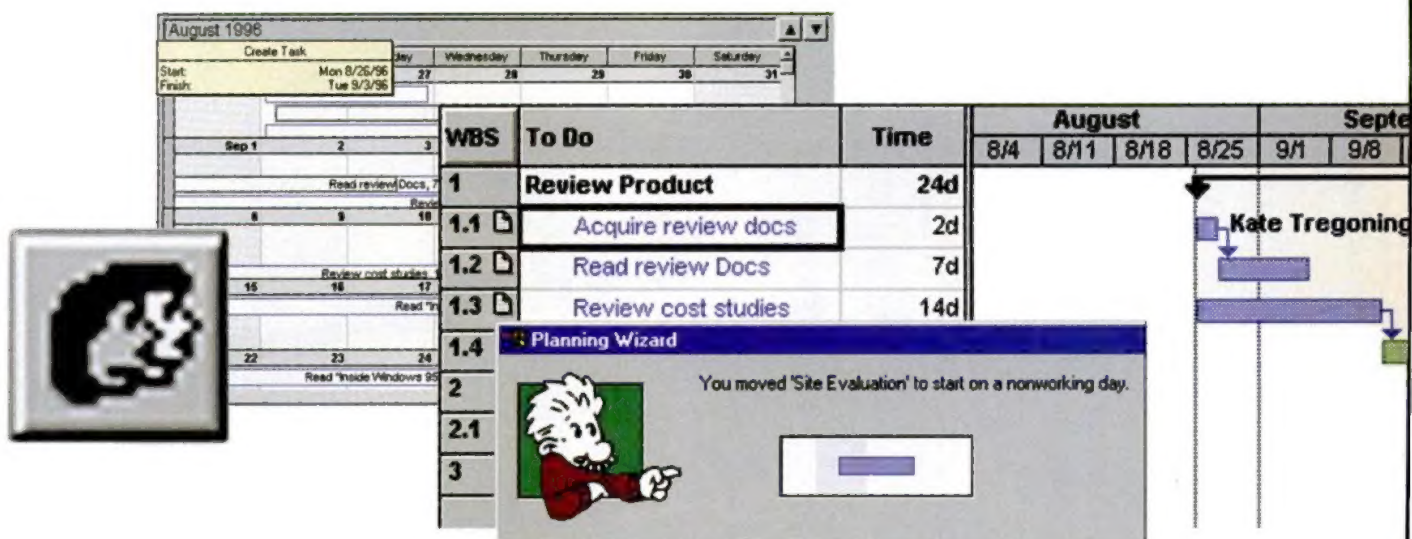
EXACTLY HOW SHARP IS THE
PICTURE ON AN NEC MULTISYNC
MONITOR WITH CROMACLEAR?



CIRCLE 157 ON READER SERVICE CARD

Microsoft Project

not only helps **plan**
it even nags



*Microsoft Project works with Microsoft Mail, cc: Mail, Lotus Notes, and the Microsoft Exchange Inbox for Windows 95.

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and manage a job, people to get it done.



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Finding the Right CPU



Which chip should be in your next PC? That's a question we ponder every year at this time, when we roll out our new benchmark tests and examine the latest crop of PCs (see page 100).

Every year, we marvel at how computers have gotten faster and faster and how much more we get for our money.

Because of this constant technological advancement, every so often we get to declare that a particular chip is "dead" and that it's time to move on to the next generation. Thus the question now arises: Is it time to write off the Pentium and move to the Pentium Pro? Well, let's take a look at the numbers.

In the accompanying chart, you'll see average ZD Business Winstone 97 scores for PCs with Windows 95 and 16MB of RAM, based on testing by PC Magazine Labs. One thing you'll probably notice is that clock speed is not the sole predictor of performance. Machines based on Intel's 200-MHz Pentium processor remain the mainstream high-end systems and are a great choice if you're running typical business or home applications under Windows 95. But there's a real competitor there, in the form of Cyrix's 6x86-P200+ (which actually runs at 150 MHz, but Cyrix calls it a P200+ because its performance is generally comparable to that of a Pentium/200). And Intel's own 200-MHz Pentium Pro is faster yet, even under Windows 95—but not all that much faster.

That's not to say there are no differences. Clearly, a Pentium/133 system outperforms a typical 486 by a huge margin. And of course, not all differences in performance are attributable to the processor; some are the result of faster graphics subsystems, bigger and faster hard disks, and other advanced components. But what's most interesting is that you don't see the jump in performance you'd expect, using mainstream

operating systems and applications, by moving up the processor scale through the Pentium line or from Pentium to Pentium Pro.

Again, part of the reason is that most of these machines share similar components. And the Pentium Pro doesn't really come into its own until you run high-end applications or a more fully 32-bit operating system, such as

Windows NT or OS/2. There you see major wins for the Pentium Pro.

All of this is likely to get more interesting in the first half of 1997. We are awaiting Pentium processors with more internal cache, which on its own may improve performance by 10 to 20 percent, and MMX

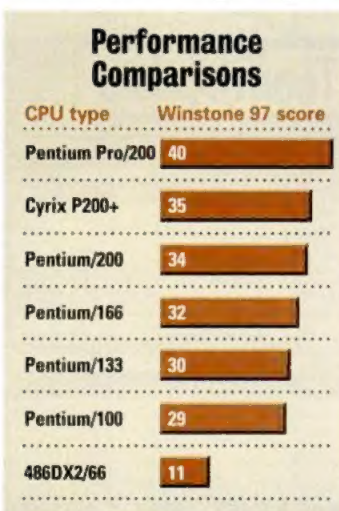
instructions, which may give an even greater boost to graphics applications and games that take advantage of them. And we'll see similar features in the next generation of Pentium Pro systems, which should be faster and less expensive, although still not suited for laptops. Around the same time, we should start to see new fast chips by Cyrix and AMD, designed to compete with the Pentium Pro.

Is the Pentium dead? Not yet. But we may well have even more choices a year from now.

Postscript: Like the processors we cover, *PC Magazine* keeps evolving.

In this issue, you'll notice a few changes, particularly a new Pipeline section on page 9 and a redesigned Trends section starting on page 28. Both are designed to bring you the most timely news and product information possible. Drop us a line at pcmag@zd.com and let us know what you think.

MICHAEL J. MILLER



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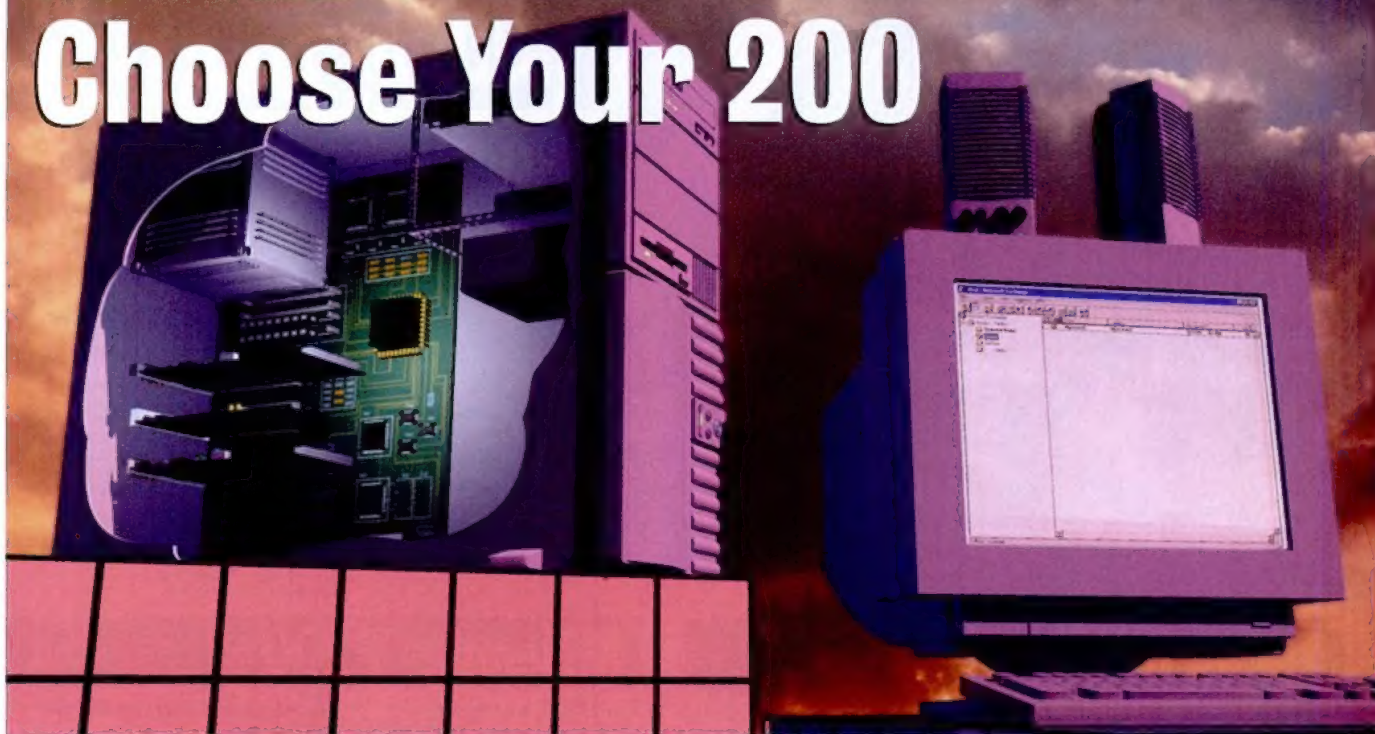
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What's New Online

Get Results

Use our exclusive interactive viewers to sort all the benchmark-test and price/performance scores for this issue's cover story, using whichever criteria interest you most. And visit us online November 18 for live coverage of our Awards for Technical Excellence.

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BY CAROL VENEZIA

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FEATURES

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3-D for Free

BY JEFF MACE

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WEB SEARCH SITES

All-Out Search



BY AMARENDRA SINGH AND DAVID LIDSKY

You can get exactly what you want from the Web even faster than you do now. See how your favorite search site measures up to the rest. You might find a new favorite or at least add one to your bookmark list. We tortured-tested ten Web search sites to see which turned up the best hits, had the most powerful features for customizing searches, and covered the richest listing of top sites. How do they do it? The search engines behind these sites

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SPECIAL INSERT

Netsearcher's Ultimate Cheat Sheet

You can master any search site with this handy guide. You get tips, information on sites and tricky syntax, and quick takes on newsgroups, metasearch sites, and White Pages.221

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Upgrade to OmniPage Pro and get the recognition you deserve.

OmniPage Limited Edition or **OmniPage Lite** is the OCR that came with your scanner. They give you basic OCR.

How to Improve Your OCR Accuracy and

Caere Corporation (NASDAQ: CAER) recently announced an upgrade that makes the OmniPage Pro optical character recognition (OCR) major software resellers for an estimated street price of only \$129. This is a very inexpensive way for scanner users to step up to fully-featured OCR product (including those bundled with flatbed and edge feed products) can upgrade to the full version of OmniPage Pro at a \$39.

OmniPage Pro has a separate upgrade package available through Computer City, Egghead, and Best Buy. Since the vast majority of Caere OCR, most scanner users are eligible to upgrade at this price.

The large number of scanner manufacturers that bundle Caere OCR (Microtek, Canon, Plustek, Umax, Nikon, Agfa, Logitech, Relays) are eligible for the upgrade.

The upgrade program includes OmniPage Pro 6.0 (Windows 3.1 and 7.0/Windows 95), which offer all the capabilities of the bundled software for extended functionality. Most notable among them are high "zoning" and preprocessing of scanned images, verifiers for the Page technology file-the retention of the original page formatting, as well as OCR training and deferred processing capabilities.

The Changing OCR Market: In the not so distant past, OCR required ware and OCR software that was often difficult to use and provided These issues were frustrating and limited the use of OCR to high volume vertical markets. The use of desktop OCR was limited to the

"Today, several trends are contributing to the widespread use of OCR users faced," said Chad Kinzelberg, Caere's vice president of market program is another major factor that will promote the use of OCR. promote the use of occasional OCR user will find Caere software more attractive because

Analysis following the OCR market agree that OCR use is on the rise industry trends promoting its mainstream adoption:

Higher Customer Awareness: An increased number of computer users time and money saving benefits it provides.

Higher Scanner Penetration: Scanners prices have dropped drastically many flatbed grayscale scanners available for under \$500. Also, and (such as the small-footprint sheet-fed scanners) and multifunction

Increased OCR Accuracy: OCR developers have developed high accuracy stage to the mainstream adoption of OCR. Pricing and Availability: and Mac) and WordScan Plus 4.0 (Windows) upgrade packages are resellers for an estimated street price of \$129. The Company Caere

Improve Your OCR and Save Big \$\$\$



Scanners are being used for document management (OCR).

CR Market:

past, OCR required hardware and OCR was difficult to use. This led to unsatisfactory results, frustrating and limited high volume applications vertical markets. The use limited to the "early

are contributing to

of OCR that overcome

users faced," said Chad

vice president of market

program is another

factor that will promote

the use of OCR. promote

the use of occasional

OCR user will find

Caere software more

attractive because

Higher Scanner Penetration:

Scanners prices have dropped drastically in the last few years with many flatbed grayscale scanners available for under \$500. Also, attractive, new scanner form factors (such as the small-footprint sheet-fed scanners) and multifunction devices have entered the market.



Low cost scanners entering the market have helped push OCR use to a new level.

Increased OCR Accuracy:

OCR developers have developed high accuracy OCR technology for increased output. The greatest improvement has been made on degraded and hard to read documents.

Pricing and Availability

OmniPage Pro 7.0 (Windows and Mac) and WordScan Plus 4.0 (Windows) upgrade packages are immediately available at major resellers for an estimated street price of \$129.

The Company:

Caere Corporation, with U.S. headquarters in Los Gatos, Calif. and European headquarters, Caere GmbH, in Munich Germany, is a leader in OCR technology and desktop document management products. Caere has recently expanded its product line of OCR

OmniPage Pro gives you almost twice the OCR accuracy with the same ease-of-use as OmniPage Limited Edition.

OmniPage Pro keeps text in its original format and layout, including graphics.

OmniPage Pro even outputs to HTML.

continued on next page

OmniPage Limited Edition

OmniPage Pro

Upgrade now to faster, more accurate OCR.

Sure, the OmniPage Limited Edition OCR that came with your scanner is good. In fact, that's why scanner makers like HP, Microtek and Agfa chose it above all others.

But if you want greater accuracy, full-throttle speed and a ton of new time-saving features, then it's time you moved up to OmniPage Pro®.

OmniPage Pro employs a new, more powerful OCR engine to recognize poor copies and degraded faxes.



www.caere.com

It integrates seamlessly with your favorite applications like Word, WordPerfect and more. It even guides you through the OCR process using its AutoOCR Toolbar. All with the simple push of a button.

What's more, you get the advantages of the world's most popular OCR software without learning an entirely new program. So make sure you're getting all the OCR power and accuracy you deserve. Call now to upgrade, or visit a local reseller.



Key Feature Comparison	OmniPage Pro	OmniPage Limited Edition
Caere's fastest and most accurate OCR engine	✓	
AutoOCR Toolbar™ for easy, one-button OCR processing	✓	
OCR Wizard to guide you through the process	✓	
Integrates with most image editors like Photoshop	✓	
OCR from within your favorite applications	✓	✓
Retains original layout	✓	

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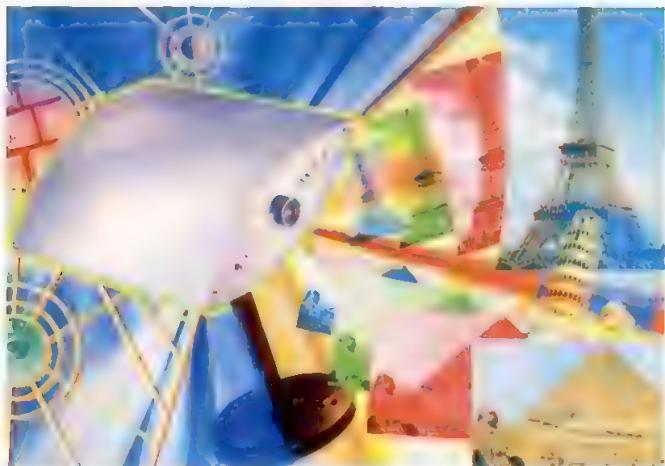
Available for Windows 95, Windows 3.1 and Windows NT.



*Suggested price US \$—subject to change. Valid in US & Canada only. Caere, the Caere logo and OmniPage Pro are registered trademarks and AutoOCR Toolbar is a trademark of Caere Corporation. © 1996. All other names are the property of their respective holders.

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Pipeline



Smile, You're on the Web

Imagine looking into a 2-million-gallon fish tank at the Oregon Coast Aquarium and seeing Keiko the killer whale swim by. Or maybe you'd rather check out the sleek new Volvo C70 on the floor of the Paris Auto Show.

You can do both over the Web with the help of a new kind of Web camera, from Lund, Sweden-based Axis Communications. The NetEye 200 is a palm-size, 1-pound digital color camera that's also a self-contained Web server. Connect the NetEye to an Ethernet network, assign it an IP address, and voilà, you're ready to snap and display photos remotely from your Web browser. Every time you click on the camera's URL, it snaps a shot, compresses it into JPEG format in about a second, and displays the image.

Until now, feeding live shots onto a Web site required a digital

camera and a separate server computer, or else a PC with a frame-grabber card and software, along with video cabling and the requisite installation headaches. The NetEye solves these problems by including Web server software inside the camera and using existing network cabling.

At this point, motion pictures are still out of the question. A single JPEG image requires 20K and video uses at least 10 such images per second, so motion video would eat up enormous amounts of network bandwidth.

Axis is aiming its NetEye at the tourism industry for displaying live shots of hotels, ski slopes, or beaches, as well as at corporate intranet applications. You can also use it for surveillance, configuring the camera to send an e-mail when somebody rings the doorbell. You can see all this for yourself at www.axis.se/neteye.



“We believe in the pot of gold at the end of the Internet rainbow.”

Microsoft group vice president Pete Higgins, on the future of The Microsoft Network.

No More Résumé Runaround

Recruiting a \$100,000 employee can cost a human resources department up to ten grand, but IntelliMatch (www.intellimatch.com), a Web-based job-search service, can lower that cost substantially—to about \$50. Close to 50,000 job seekers have already filled out structured résumé forms and attached text files of their real résumés, all for no charge. Employers run a database search that ranks candidates for the best matches. Each time an

**IntelliMatch
Candidate Query**

employer downloads the details of a candidate, it's charged \$50. IntelliMatch, which has Knight-Ridder as a backer, is starting to show up at online newspaper sites, such as that of the San Jose Mercury Center. You can see it in action at InfoSeek (www.infoseek.com), too. IntelliMatch is selling software for internal intranet use as well.

56-Kbps Frenzy

Last summer, reports spread that modem speeds had maxed out at 33.6 Kbps. After all, the phone system had its practical limits.

So much for limits. In September, an international standards-setting group received a proposal to bump up modem speeds to 56 Kbps—just shy of ISDN's

64-Kbps single-channel rate. Rather than wait out a lengthy review process, modem maker U.S. Robotics introduced its own 56-Kbps technology in October. Dubbed X2, it transmits data one way only—downstream, from your ISP to your modem. The upstream channel is still limited to 33.6 Kbps.



Online: Interactive PC Reviews

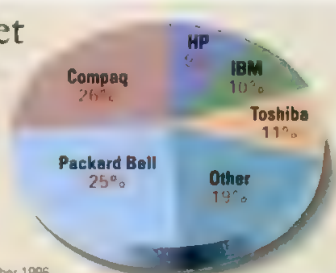
If you're planning to start out 1997 with a new PC, you're no doubt still trying to decide which system is perfect for your particular needs. Visit PC Magazine Online and find out. By using our exclusive interactive benchmark test and price/performance viewers, you can sort the results for all the systems evaluated in this issue's cover story by whichever criteria interest you the most.

VIVA LAS VEGAS. From November 18 to 22, we'll be among the hordes at Comdex, the biggest computer trade show of the year, sending back reports about the hottest new technologies on display. Don't forget to join us on the evening of November 18 for live coverage of PC Magazine's Technical Excellence Awards show. Formal attire is not required.

ALSO ON THE WEB. You'll find commentary, updated weekly, from John C. Dvorak, Michael J. Miller, and Don Willmott; daily Trends stories analyzing the latest developments in computing; and daily reviews of new Web products in InternetUser.

Retail PC Market

Market shares for the top PC makers in the retail market have shifted since early this year, with Compaq pulling ahead of Packard Bell. The PC market reflects the choices of second-time buyers, who look for quality over price.



Source: CI StoreBoard Channel Tracking, September 1996

Pipeline

Hi-Fi Ink Jets

How many colors will that be? Recent developments in the ink jet printer market suggest that HiFi color—a printing technology that increases the accuracy with which bright colors and photographic images can be reproduced by expanding the number



DESKTOP DARKROOM: An image printed with Lexmark's six-color process produces far better flesh tones than those of a four-color image.



printer. The kit—expected to have a street price of \$60 to \$70—includes new printer drivers and two tricolor cartridges containing black, yellow, two shades of cyan, and two shades of magenta. According to Lexmark, the technology is based on “an exclusive formula... that results in impressive photos with reduced grain and improved color depth.” Translation: You can print more-realistic-looking photos.

Hewlett-Packard has announced a six-color upgrade technology as well. Its

PhotoColor Kit will cost around \$50. And Mutoh America has announced that its new large-format ink jet printer, the SpectraJet HiFi, will use the Pantone Hexachrome ink

of printing inks from the standard four colors to six, seven, or even eight colors—may start moving into the mass market.

The first HiFi ink jet product will be a conversion kit for the Lexmark 2050 desktop ink jet

system. Hexachrome adds green and orange to the normal CMYK mix. Mutoh will price the printer under \$10,000 to compete with the four-color large-format ink jets from Encad and Hewlett-Packard.



Plugging In At 30,000 Feet

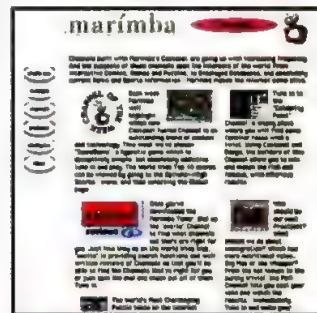
In December, American Airlines plans to begin outfitting its first-class and business-class seats on certain international flights with 12-volt “power ports” so passengers can plug in their notebooks and not worry about draining their batteries. Initially, the airline will install the power ports on Airbus A300 planes that fly American’s premier trans-Atlantic routes.

In light of the concern over the interference of electronic devices—such as notebooks, cellular phones, and electronic games—with airplane navigational equipment, especially during takeoff and landing, American will provide juice to the outlets only at altitudes above 10,000 feet. As always, American advises that “passengers should follow flight crew instructions that prohibit the use of electronic equipment during takeoffs and landings.”

Tuning In To the Web

If the proponents of a “channel” metaphor on the Web have their way, we might be tuning into multimedia-enhanced Web sites in much the same way we tune into TV channels. Marimba (www.marimba.com), a Silicon Valley start-up, is leading efforts to develop Java-based Web channels.

Marimba’s Castanet (get it? Cast-a-net) “tuner” software downloads channel files from servers and onto client computers, delivering updates as they



CHANNEL FLIP: Marimba’s channels range from games to news.

come in. A sports-score channel could receive new scores every few minutes, and users could subscribe to software upgrades.

Castanet may sound a bit like PointCast. It is. But Marimba believes channels and ticker-based information apply to far more than just news—the channels now linked to Marimba’s site also include interactive comics, games, puzzles, and databases.

Advertising Intimacy

Like it or not, Web advertisers want you, and they’ve come up with some creative ways to capture demographic slices. Internos Productions, a Hollywood-based Web company, hopes to draw the 18- to 24-year-old crowd into its mystery series, The Family Jewels, which recently debuted at www.iontheprize.com.

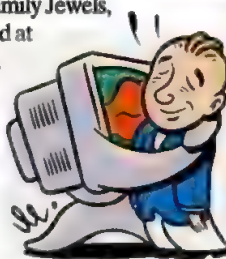
The idea is to lure visitors into spending 35 to 45 minutes per week solving a mystery. The answers are found in the site’s multipage promotions from companies such as K-Swiss and Twentieth Century Fox. The prize? A cool \$25,000.

Meanwhile, Web services company Ikonix—producer of

sites for Virgin Records and Pacific Bell—is pitching a similar strategy to potential Web advertisers and has even trademarked a term for it: *Consumer Intimacy*. By eliciting customers’ individual preferences and monitoring

spending habits, advertisers are able to deliver tailored products and services. Explains Ikonix CEO Robert May, this isn’t a new idea: “The butcher knows you want roast every Friday. If he

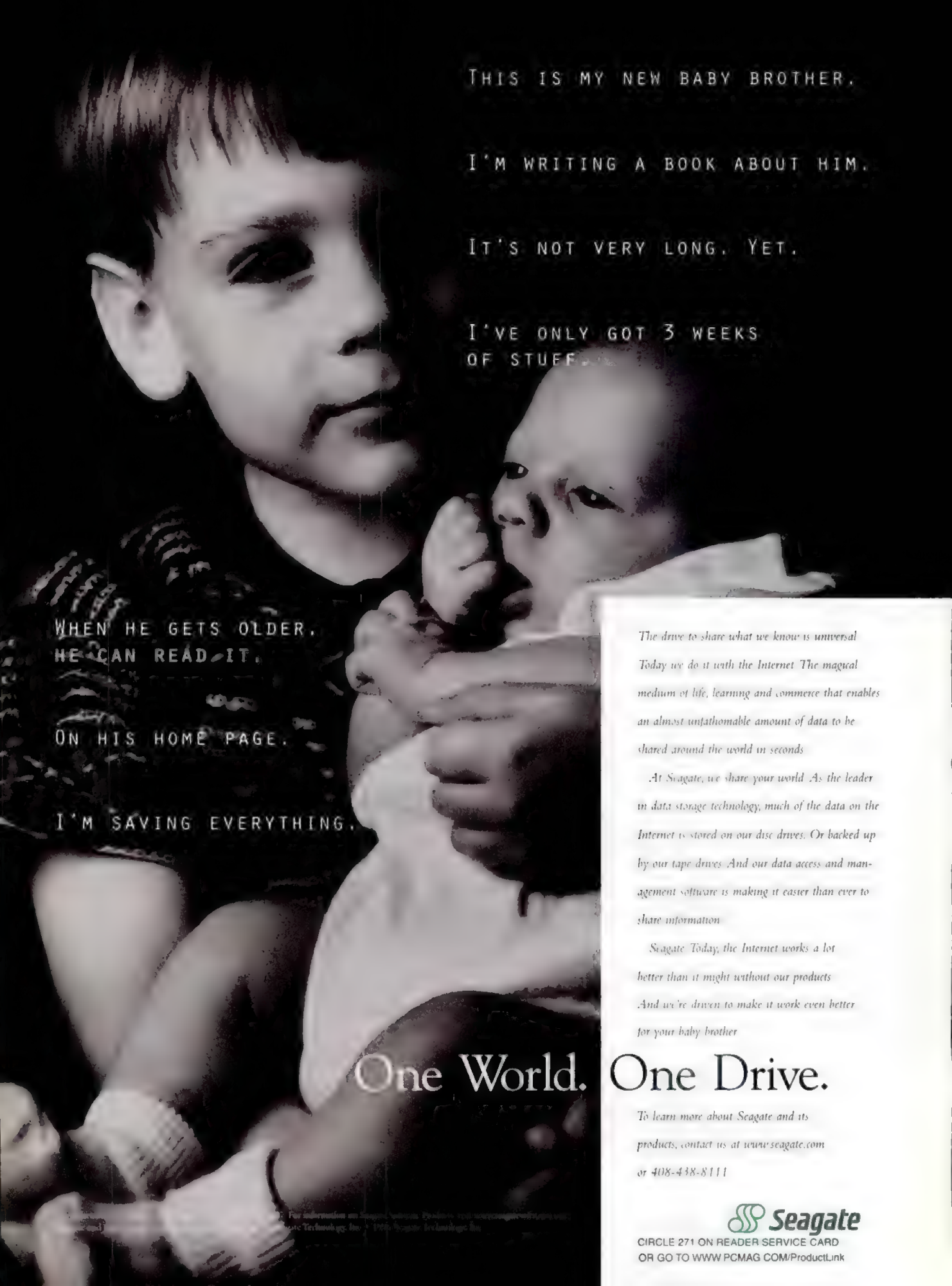
doesn’t have it, he’ll go out and get it.” May predicts the use of “privacy knobs” that let you change the amount of information you share on a Web site.



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*Source: PC Data. Data for September 1996.



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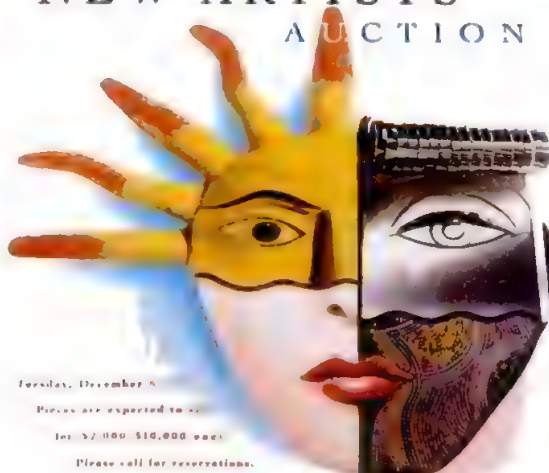
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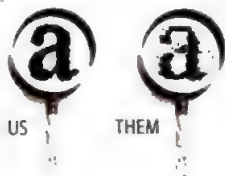
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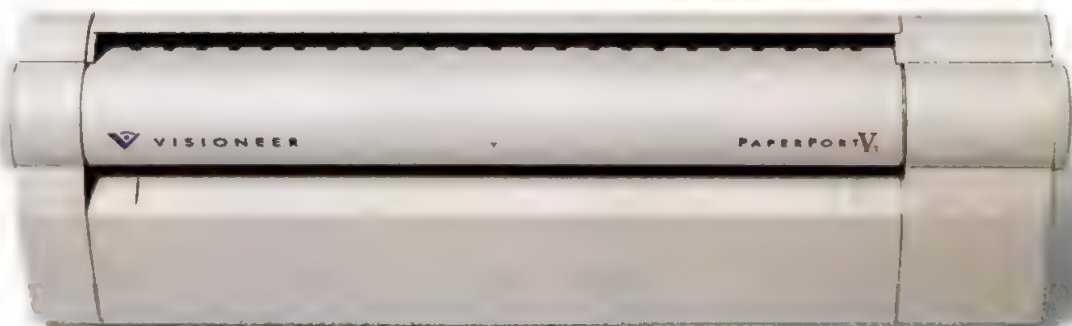


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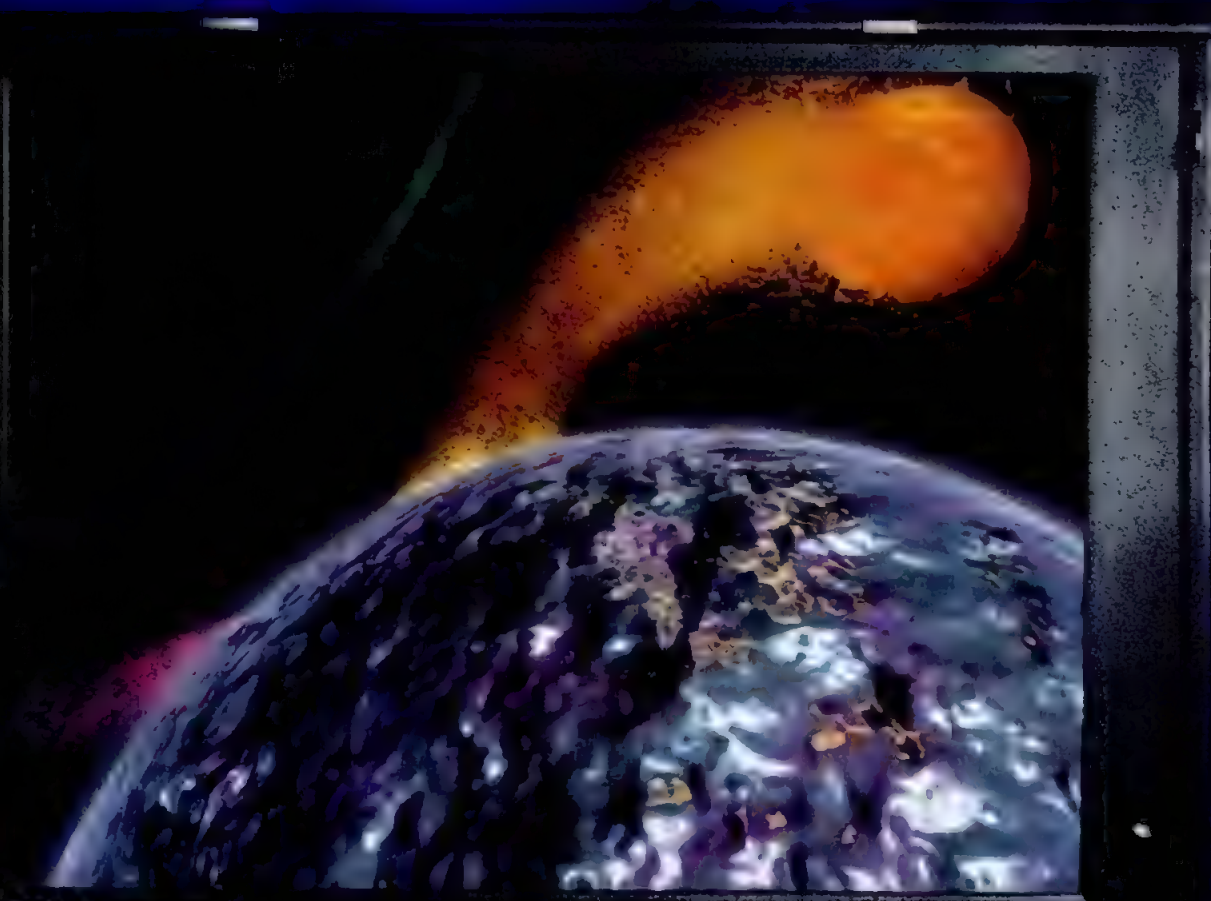
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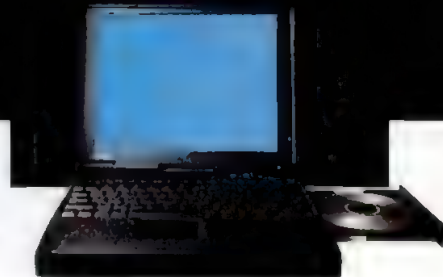
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CIRCLE 196 ON READER SERVICE CARD

Letters

DVORAK ON UNIX

I take exception to John C. Dvorak's advice to Netscape: "Get out of Unix hackdom" ("How to Beat Microsoft," September 10, 1996). Unix has traditionally been the programmers' and hackers' premier platform, the operating system where the Internet began, and it remains the operating system of a majority of network servers. Now that Linux has revived interest in Unix, it might again become a center of innovation. I will grant you that Linux is not appropriate for the average computer user, but recommending that Netscape leave the Unix arena is an error in judgment.

MENDEL COOPER
via the Internet

While I have gotten used to Dvorak's consistent ignorance of Unix, this is by far his most inaccurate statement. He is ignoring the fact that the Web server market is dominated by Unix systems. For Netscape to stop developing Unix server software would be fatal.

BRENT METZ
via the Internet

Why does Dvorak feel the need to slam Unix? Our servers could not handle the load they carry using a Windows NT solution. In fact, I think that Windows NT is much more likely to drop connections under a heavy load than a similar Unix server.

ANDREW WILLIAMS
via the Internet

I found Dvorak's comment concerning Unix and the "college kid mentality" to be very flattering to a 45-year-old convert who fled the Microsoft camp. Through my good fortune of



Why does Dvorak slam Unix in every column he writes?

shoulder" account for my shoulder pain. I thought it was just a severe case of muscle tension. I've tried everything: massages, physical therapy, a split keyboard, even living on Advil.

CATHY EASON
via the Internet

I read with great interest Dvorak's comments on "mouse shoulder" syndrome. Unfortunately, I am following in his footsteps (or keystrokes?) by using my PC's touch pad improperly. I have already been to an orthopedic surgeon who seems unable to help. However, I did find some information on the Web at Cornell Ergonomics Web (ergo.human.cornell.edu) as well as at MedLine (www.ariessys.com/Pages/CoreJournalsMEDLINE.html). Both include interesting material, but it

form Microsoft Word into an HTML viewer. This is true to some extent, but only for stand-alone use. The program acts as a nice HTML viewer, but when on a network, it can be used only by one client at a time. Microsoft Word will not allow multiple copies of the program to be open at once.

SHANE MCCOY
via the Internet

You failed to mention the easiest way to build a Web site—and, not coincidentally, the method that's most popular among professional Web and graphic designers: Use a Mac.

ERIC TREANOR
via the Internet

ROUNDUP RESULTS

Thanks for your recent review of HTML editors, "Web Authoring" (September 10, 1996). I have been searching for a good editor, and your article helped a lot. However, I felt the story didn't adequately address the needs of Windows 3.x users. I wish you had made it easier to determine which editors were Windows 3.x-compatible—and which were the best.

TIM TESAR
via the Internet

I agree that GNNpress is a nice piece of software at an unbeatable price. Its filename limitations can get you into trouble, however. The program accepts long filenames, but it truncates them just as Windows 3.x programs do. This leads to mismatches when everything is sent to a Web server. The only solution is to make sure that all filenames appear in 8.3 format.

PAUL PLATT
via the Internet

I enjoyed your review of HTML editors. Al-

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SOMETHING
REMARKABLE
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CIRCLE 305 ON READER SERVICE CARD

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Letters

facturers. Many of the companies already build CD-ROM drives and video monitors. By manufacturing both the components and the final product, they should be able to increase their profits.

KENT E. BOZENSKI
via the Internet

TOY STORY

The description of XMouse as a "silly thing" (Inside Windows 95, September 10, 1996) is far from accurate. Experienced Unix users know how to exploit this feature of controlling input focus, which allows users to maximize the potential of overlapping or cascaded windows. On small monitors, desktop space is limited, and it isn't always possible to size windows side by side to allow full viewing of both. By overlapping windows, the user can monitor the foreground window while a process runs, and can still process input into the background window.

F. WONG
Winnipeg, Manitoba, Canada

Contrary to your report, XMouse doesn't emulate the functionality of the X Window mouse focus. In XMouse, the window border changes color, but the window doesn't have focus, so you can type or mark text in it while another window remains on top of it. Once you use this feature of XMouse, you'll wonder how you got along without it.

BRYAN PETTITT
via the Internet

I've been looking for a program like XMouse since I got my new PC. The problem is that it's not like the X Window mouse. The input

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CORRECTIONS AND AMPLIFICATIONS

For the October 22, 1996, First Looks article "Home Is Where the PC Is" (page 39), the correct phone numbers for Toshiba are 800-334-3445 and 714-583-3000.

focus is on the window where your mouse is, but it doesn't allow the user to click on the window without raising it to the top. As a result, its usefulness is somewhat diminished.

SHARK MOK
via the Internet

LOOK OUT

For many users, Powertoys could create problems, particularly as it's "unsupported" software for which even the authors won't accept responsibility. Users may waste a lot of time recovering from the enhancements, rather than benefitting from them.

MARK GLEASON
Santa Ana, California

POLITICS 101

In the Trends article "Voters Flock to the Web" (September 10, 1996), you reported on a survey purporting to uncover the political leanings of Web users. However, the article didn't mention what may be the most important political development on the Internet: cyber-Libertarianism. This movement has been particularly active since the passage of the Communications Decency Act. In fact, the article never questions the validity of the tired old liberal/moderate/conservative political spectrum.

DAVID J. EDMONDSON
via the Internet

MEMBERS ONLY

Concerning the First Looks article "Microsoft Takes the Offensive in the Browser Battle with Netscape" (September 10, 1996): I was frustrated that so much was made of the fact that Microsoft is pushing to integrate Internet Explorer into Windows 95, while Netscape missed the boat. I think Netscape was smart not to spend the time and money on operating-system/browser integration. Netscape didn't create Windows 95, so it can't possibly integrate a browser as successfully as Microsoft can, but then again, it doesn't have to. If Windows 95 becomes an operating system with an integrated browser, only Windows 95 users will be able to use it. Netscape is right to create versions of Navigator for as many operating systems as it can and not consider this a limitation.

JOHN STAHR
via the Internet

ISSUES AND ETHICS

Michael J. Miller's September 10, 1996, editorial on conflict-of-interest issues ("Mergers & Apprehensions") was thoughtful and well written. While he should be commended for

addressing this issue, I was struck by the lack of any reference to ethics. His main argument for avoiding conflicts seemed to be "It's not worth the risk." Do we then conclude that if it were worth the risk, he would? While not a starry-eyed idealist, I would have hoped for at least a passing reference to the concept of right and wrong in the setting of modern-day journalism.

TOM DIETSCHKE
St. Paul, Minnesota

SPIILLED MILK

I have been anxiously awaiting a time when a computer columnist such as Jim Seymour might write something like "The Removable-Storage Mess" (September 24, 1996). While I wholeheartedly agree with Seymour's recommendations of CD-R, PD/CD, and MO disks, I vehemently disagree with his recommendations of the Iomega Zip and the 3M/Matsushita LS-120 for primary storage. They store large quantities of data on flexible media, which, in comparison with rigid media, have limited reliability. Rigid media usually fail because of some catastrophic event, while flexible media are more likely to fail during normal use or a change in the environment. Because of inherent reliability problems, flexible media cannot and should not fill the role of primary storage.

TOM CAVANAUGH
Upper Marlboro, Maryland

If only it were as easy as Jim Seymour makes it seem! The problem is, no computer user is an island. Many of these removable-storage devices will find their way into businesses that need to exchange data with others, and the decision to use or not to use the services of a particular business will depend partly on the disk formats it offers. Since a Zip disk doesn't fit in a Jaz drive, you just can't communicate easily. The cartridges themselves have as many different shapes as my kid's Lego set.

TOM ZEBOVITZ
Colonia, New Jersey

DON'T DO IT YOURSELF

I recently read your October 8, 1996, article "Widen Your Horizons," in which you compared 17-inch monitors. I must congratulate you. Your tests were thorough and full of information. I'm in the market for a new monitor, and I was dreading having to research the massive number of computer monitors available today. Your article made that unnecessary.

DARIN FENNELL
via PC MagNet



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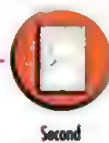
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P.133

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Trends



Half Open or Half Closed?

Microsoft, Netscape, and Sun square off over Web components.

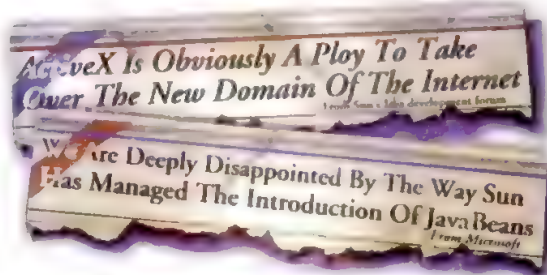
The rush is on to marry Internet-based software components with operating systems and application software, pitting Microsoft's ActiveX strategy against the open-computing strategy of archrival Netscape, with Sun Microsystems' Java figuring heavily into Netscape's vision.

At issue is how Internet-enabled networked desktops will bring distributed objects together into applications. Netscape's take is that Microsoft's strategy remains Windows-centric, and that what users really want is a world of networked software components targeted at platform independence. The company is out to blend browser and operating system into a single cross-platform desktop environment, called ONE.

Sun has positioned its Java and accompanying JavaBeans object model as open, cross-platform standards, earning Netscape's approval. Microsoft has also included Java support in Internet Explorer 3.0.

In an atypical move for Microsoft, the company recently gave away part of its ActiveX protocol to the Open Group, an independent standards consortium. Microsoft has positioned this move as an answer to criticism that ActiveX is an extension of the company's alleged desktop-dominating "API lock-in strategies," which critics say steer software toward the Windows platform.

According to Sun's Dave Spenhoff, "What Microsoft has done is define a subset—and subset is the key word—of the pieces required for running ActiveX components for the Open Group to manage. This subset is represented as ActiveX Core Technologies. Server-side hooks, multimedia hooks, and OLE controls are not part of ActiveX Core Technologies, so you must bind your ActiveX component to a Win32 platform."



If users take to marriages between ActiveX and Office applications, then Windows, Internet Explorer, and other Microsoft applications could become the de rigueur containers for Internet-based software components. But Netscape isn't sitting still: Recently, the company announced new client software called Communicator that has the same features and can support OLE and some ActiveX objects.

The actual specification Microsoft plans to

turn over to the Open Group amounts to platform-independent definitions of Microsoft's Component Object Model (COM), Distributed COM, Microsoft Remote Procedure Calls, OLE Automation, a Registry structure, and several other ActiveX services. The rub is that Microsoft is holding onto key technologies, such as the source code for "core OLE," and that versions of Internet Explorer for other platforms aren't available.

Online postings from JavaSoft officials in Sun's Java forum claim that "because Java runs on all platforms—including Windows 3.1—a programmer never has to worry about facing the dilemma of paying the cost to upgrade and re-port existing applications." With ActiveX, developers currently have to port components from one platform to another. With JavaBeans—the component architecture added to the Java specification—developers can write one component that will work on every platform. One developer on JavaSoft's Web forum says that though it's true that Microsoft has made commitments to port ActiveX to other platforms, "we'd love to hear specifics on the dates these ports are expected."

Microsoft's Cornelius Willis says the company's delivery of key products will tell the story. "We don't view non-Windows platforms as write-offs," he says. "We will deliver Internet Explorer and ActiveX support on leading Unix platforms and on the Mac before the end of this year. We will also deliver the same performance and the ActiveX-enhanced Java virtual machine on those platforms at the same time."

These things have all been promised by the end of 1996, making the end of this year the true testing ground for Microsoft's commitment to ActiveX as a cross-platform component standard and to Sun's Java.

The Open Group will vote on Microsoft's proposed specification by November. If the proposal is approved, Microsoft can extend the ActiveX specification inside

its products but not change the specifications it has submitted without a two-thirds majority approval by the Open Group.

Above all, the coming months promise to prove which breed of software components will truly embrace multiple platforms, and how stringent developers and users will be in their demand of cross-platform components.—*Sebastian Rupley*

Don't Think PCs, Think TVs

The new MSN has channels and shows.

November's relaunch of The Microsoft Network (MSN) resembled the rollout of a new TV network as much as it did the launch of a totally reworked online service. Amidst much talk of shows, channels, studios, and programming, the new MSN has emerged as a fully Web-based service, with Microsoft optionally acting as the Internet service provider.

With 1.5 million subscribers after 14 months of existence—it's currently the third-largest online service, behind America Online and CompuServe—MSN is



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positioned for big growth in a market that's increasingly shunning the proprietary online services.

For \$19.95 per month (including Internet access; \$6.95 per month if you get your Internet access elsewhere), you can benefit from MSN's attempts to blow past its main competitor, America Online. MSN promises to bring never-before-seen animation, graphics, and interactivity to its subscribers. In addition to reference and shopping services—including Microsoft Investor, CarPoint, the impressive new Expedia travel service, and Web versions of Cinemania, Music Central, Wine Guide, and Encarta—MSN offers six "channels," each one containing several "shows."

On Channel 1, you'll find MSNBC. Channel 2, which is dedicated to mainstream entertainment, includes the Entertainment Tonight and Star Trek sites. The educational Channel 3 includes the adventure travel show Mungo Park, the online magazine Slate, a history show, and a music site. Channel 4 deals with style and relationships. Channel 5's e-zines target 18- to 27-year-old Generation-X types. And Channel 6 provides chat rooms and games for kids and teens.

Will Microsoft make money with this new and improved endeavor? Group vice president Pete Higgins is optimistic, but says "there are a couple of leaps of faith in the business model." Microsoft CEO Bill Gates is cautious as well: "People should be very conservative about seeing profitability in interactive efforts like ours in the next three years."—Don Willmott



That's No Way to Speed Up Graphics

GRAPHICS CARD VENDORS LIVE AND DIE by performance results, so it's no surprise they do their utmost to maximize the speed of their products. During testing for this issue's graphics accelerator story, "3-D for Free," PC Magazine Labs discovered that a controversial optimization technique known as *GDI bypassing*, which a number of vendors have recently implemented, is ineffective. In GDI bypassing, the graphics driver intercepts certain graphics operations normally processed by the Windows Graphics Device Interface (GDI) subsystem and processes them itself.

Some companies claim that this bypassing technique improves application performance. Others maintain that GDI bypassing artificially inflates benchmark test results without providing real-world benefits. Microsoft condemns GDI bypassing, stating that the technique can introduce compatibility problems and lead to possible system crashes. Can any of these claims be substantiated?

PC Labs' testing—using the new ZD Winstone 97 and ZD Graphics WinMark 97 benchmark tests, whose specifics are covered in this issue's PC Tech section—demonstrated no significant performance gain for GDI bypassing on either applications-based or synthetic benchmark tests. We have no first-hand evidence that GDI bypassing introduces compatibility problems, although a number of vendors acknowledge that applications such as remote-control and whiteboarding are potentially vulnerable to such complications.

A SHORTCUT TO NOWHERE

A graphics card that employs GDI bypassing intercepts graphics calls and, in some cases, performs certain GDI func-

tions in its board-specific device driver rather than in the potentially inefficient GDI subsystem, which includes clunky 16-bit code inherited from earlier generations of Windows.

In both the standard processing case and the case involving GDI bypassing, an application would call a Windows graphics application programming interface (API) function to draw text, for instance, or a pattern on the screen. The API call would then invoke a function in GDI.EXE.

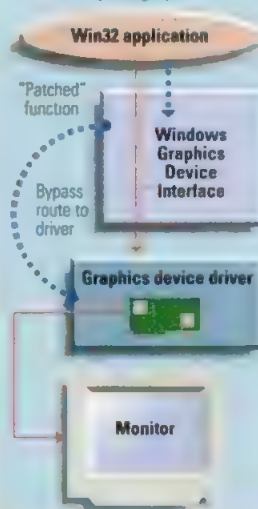
With no GDI bypassing in place, the GDI subsystem would handle some house-keeping operations, such as clipping, then call the device driver for the graphics card

to perform the drawing operation. GDI bypassing alters this usual sequence of events. The graphics device driver knows what locations in GDI.EXE are called by various graphics API functions, and actually modifies the code to pass control to the device driver. When an application makes a GDI call, the call is intercepted and routed to the device driver without the GDI's knowledge. This lack of knowledge is one of the main compatibility concerns Microsoft has raised. If the GDI subsystem is unaware of the operation, certain of its internal structures may not be updated properly and could cause problems in later processing.

To evaluate the effects of this supposed optimization, we used a specially constructed utility to detect which boards were performing GDI bypassing. We then asked each vendor to provide a switch to turn off GDI bypassing. Each vendor eventually complied, and the results demonstrated that no advantage appeared when GDI bypassing was enabled.—Jeff Mace

How GDI Bypassing Works

Some graphics cards redirect certain functions around the Windows GDI in an attempt to speed graphics.



Superchips Take Aim at Intel

AMD, Cyrix, and Exponential gear up.

The Pentium Pro has competition: This fall's Microprocessor Forum saw the introduction of three new processors that will vie for the high end of the desktop PC market. AMD and Cyrix each announced an x86 chip optimized for 32-bit performance (the K6 and M2, respectively), and Exponential Technology debuted a PowerPC-compatible chip—the Exponential X⁷⁰⁴—that lays claim to having the world's fastest clock speed.

Cyrix's M2 chip provides an easy upgrade path from 16- to 32-bit computing. Like the Pentium Pro, it's optimized for 32-bit performance, but unlike the Pentium Pro, it's also optimized for 16-bit code and can plug into a standard 64-pin

socket—such as the one found on the current Pentium. As a result, those who are currently running the semi-16-bit Windows 95 with a Pentium can gently upgrade to an M2 as they make the leap to Windows NT 4.0, without investing in a new Pentium Pro system. Those who are not yet ready for 32-bit computing can buy an M2 machine and run it with Windows 95 until the time comes for moving to Windows NT. The M2 also has a 64K internal

cases—75-MHz bus speeds (the Pentium Pro is currently limited to 66 MHz).

AMD's K6 processor is also optimized for both 16- and 32-bit code, plugs into a standard Pentium socket, and supports MMX. Its primary cache, however, is only 32MB, and it will not support a 75-MHz bus. Although the M2 will have clock speeds of 180 to 225 MHz and the K6 will run at 180 to 200 MHz, each will be named according to the new P-Rating system, which reflects relative performance rather than clock speed.

For those who desire Pentium Pro performance on a Mac, Exponential Technology is offering the Exponential X⁷⁰⁴ chip. At 533 MHz, it's the world's fastest PC microprocessor. The Exponential X⁷⁰⁴ can run the Mac OS as well as Windows NT, is meant for typical desktop PCs, and uses standard power supplies, heat sinks, and cooling fans. When the chip is produced in volume sometime during the second quarter of 1997, it will also be available in 466- and 500-MHz versions.—Cade Metz

Heavyweight Challengers

PC manufacturers expect to have three new high-end microprocessors in their hands sometime in the first half of 1997.

	Clock speed	Architecture	Pin-compatible with
AMD K6	180 to 200 MHz	Optimized for 16- and 32-bit x86	Standard Pentium socket
Cyrix M2	180 to 225 MHz	Optimized for 16- and 32-bit x86	Standard Pentium socket
Exponential X ⁷⁰⁴	466, 500, 533 MHz	PowerPC	PowerPC socket

cache (the Pentium Pro's is 16K), MMX extensions (not included on the Pentium Pro until the first quarter of 1997), and—in some

JAKE KIRCHNER

Keep Your Darned Hands off My Hard Disk

The arrival of my new PC and its \$269, 2.1GB hard disk served as a reminder that the per-megabyte cost of PC storage continues to plummet. And a good thing, too, considering how many people want a piece of that space.

Installing just the operating system and the minimum number of applications I need ate up 500MB. I suspect my experience is pretty typical. And it's not only the still-expanding office suites that are swallowing more and more of our storage—although it's true that suites are the main offenders, with the full installations of Corel Professional Office, Lotus SmartSuite, and Microsoft Office Professional—taking up several hundred megabytes of disk space.

Just as ravenous as these applications—though feeding with smaller bites—are the stacks of CD-ROMs piling up on most desktops; these CDs can easily demand 5MB apiece. Not to be outdone, the online services are rushing to the head of the gigabyte-grabbing pack. My CompuServe directory takes up 5MB and is spread over 307 files—and that's the minimalist approach. The newest version of The Microsoft Network requires 50MB of disk space.

More alarming in this growing demand for hard-disk real estate is the fact that the Internet, which was supposed to rescue us from the disk-hogging tyranny of "old-line" multimedia offerings like CD-ROMs and online services, is even worse. My fairly minimal installation of the PointCast Network requires more than 1,000 files that take up almost 14MB of space.

The latest example of the Internet-based storage stealers is the Castanet software from Marimba, a new company formed by sever-



al members of the original Sun Java team. Castanet lets you store locally (on desktop clients and servers) the kinds of Internet applications you're used to downloading time after time from the Web. With Castanet, the applications are updated in the background whenever you're connected to the Internet, which means you can run them from your hard disk any time you want, whether you're connected or not.

The Castanet approach may mean you don't have to worry about bandwidth restrictions or inefficient Java

compilers, but it also means you need to hand over considerably more hard-disk space to Web surfing than what you're used to. The technical difficulties of providing large Java-based apps over the typical modem- or network-based connection have kept Java apps small and fairly uninteresting. With Castanet, those size limitations fall away.

Castanet may prove a real boon to the hard-disk makers of the industry, but it spells doom for the widespread adoption of network computers. Those cheap, diskless desktops just aren't going to be adequate for Internet connections if more and more of your favorite sites demand several megabytes of local storage.

Fortunately, the storage companies continue to increase the capacity of their drives while the cost per megabyte continues to drop. Leading PC vendors already are shipping 3.2GB drives as standard features. And advances in other types of technologies, such as DVD and phase-change, carry the promise of almost unlimited storage.

Unlimited storage is an interesting concept. It makes you wonder what kinds of applications might be possible. Looks like we're going to find out pretty soon.

Designed for Microsoft BackOffice means your business applications will live together happily ever after.



You know how complicated it can be to get your new stuff to work with what you already have, considering all the software and hardware configurations you deal with every

day. To make your life easier, you need solutions that can get along. But how do you choose the ones that will? Microsoft has made it simple with one sure sign. Just look for the Designed for BackOffice™ logo, and you can count on the fact that that product will fit smoothly into your community of BackOffice applications, including Microsoft® Windows NT® Server. We can make that promise because we rigorously test each product to make sure it can meet a variety of requirements. Some of the best-known applications in the industry proudly bear the Designed for BackOffice logo. For a complete list of products, visit our website at www.microsoft.com/backoffice/designed/. Then your applications can work

Designed for BackOffice Logo Criteria

Server

- Must run as a Windows NT Server service
- Must support both IPX/SPX and TCP/IP
- Must support Windows® unified logon
- Must be installable using Systems Management Server
- Must support ISAPI if

Client

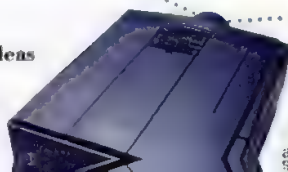
- Must support industry standards in each client category (ODBC, MAPI, for example)
- Must be installable using Systems Management Server
- Must have at least a 16-bit Windows-based client (Win32® client preferred)

The smallest, lightest,
brightest multimedia projector
 is now an even brighter
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Introducing the Epson ELP-3300, the world's smallest, lightest and



Easy-to-Use & Versatile. In just seconds, you can connect to any PC, Mac, VCR or camcorder. The ELP-3300 supports full-motion video, colorful text, animated graphics and stereo sound to



Epson's Prism Technology, and 3 advanced LCDs (not just 1) produce the brightest, high-quality images.

DESKTOP PCs

PCs Gain 12X CD-ROMs

The ceiling on CD-ROM speed just went up a notch: The first PCs with 12X CD-ROM drives have made their way into the market.

The 12X Hitachi CDR-8130 CD-ROM drive is available as a standard or upgrade option in Micron Electronics' line of Home MPC machines (800-209-9686, www.mei.micron.com). The drive has a variable data-transfer speed, depending on which part of the disk it is reading from. In addition to the 12X CD-ROM

drive, the \$2,899 high-end **Home MPC P200** includes a 200-MHz Pentium CPU, 32MB of EDO RAM, a 2.1GB hard disk, a Diamond ViRGE 3-D graphics card with 2MB of EDO RAM, a Crea-

200-MHz Pentium Pro systems. All other Gateway systems can be upgraded from 8X to 12X for \$49. The \$2,999 **Gateway G6200 FPC** has a 200-MHz Pentium Pro CPU, 64MB of EDO RAM, a 3.8GB IDE hard disk, a 3-D graphics card with 4MB of VRAM, an Ensoniq Vivo sound card, a Telepath 33.6-Kbps modem, and a 17-inch monitor.



tive Labs Sound Blaster AWE32 sound card, and a 17-inch monitor.

Gateway 2000 (800-846-2000, www.gateway.com) offers 12X CD-ROM drives as standard on 200-MHz Pentium and 180- and

SDRAM, a 3.2GB hard disk, 512K of external cache, Number Nine's ViRGE 3-D graphics card with 2MB of VRAM, integrated 16-bit sound, a U.S. Robotics Sportster 33.6-Kbps modem, and a 17-inch monitor.

Canon Computer Systems (800-428-4123, www.ccsi.canon.com) offers three systems incorporating 12X CD-ROM drives, including the \$2,399 **Innova Media MT 9630**, a 166-MHz Pentium system with 16MB EDO DRAM, a 2.1GB hard disk, 3-D wavetable audio, and an S3 ViRGE 3-D graphics card.

MidWest Micro (800-728-8582, www.mwmicro.com) offers 12X CD-ROM drives on PCs with Pentium/166 or faster CPUs. On other systems, it costs \$39 to upgrade from 8X to 12X. The \$2,599 **P5-200 Office PC** comes with a 200-MHz Pentium CPU, 16MB of SDRAM, a 3.2GB hard disk, an ATI 3D ProTurbo PC2TV graphics card with 4MB of SGRAM, a Creative Labs Sound Blaster 16-bit sound card, and a 17-inch monitor.—*Robert S. Anthony*

RECAP See our latest round-up of 200-MHz Pentium and Pentium Pro systems in this issue.

In our September 24, 1996, review of 200-MHz Pentium Pro desktop PCs, the Editors' Choices were

- ▶ NEC PowerMate Pro 2200
- ▶ SAG STA Pro 200 Desktop

In our First Looks review of home PCs, the Editors' Choice was the Toshiba Infinia 7200.

NOTEBOOKS

The Need for Speed, IR Style

Are you tired of going through the floppy disk shuffle to move data from your notebook to your desktop PC at the end of a business trip? Help is on the way, in the form of fast infrared (FIR) ports that go beyond the abilities of early infrared ports, which limited standard communications to a maximum speed of 115.2 Kbps.

The extended IrDA standard supports data transfer rates of up to 4 Mbps. At 35 times the speed of the old limit, these FIR ports offer promising new uses, such as

wireless connections to a network at a reasonable speed.

Among the first of the FIR notebooks is the \$4,999 **Portégé 660CDT** from Toshiba America Information Systems (800-334-3445, www.computer.toshiba.com), which comes with a 150-MHz Pentium CPU, 16MB of EDO RAM, a 1.2GB hard disk, an 11.3-inch SVGA active-matrix display, and an integrated 28.8-Kbps modem.

RECAP The Editors' Choice selections in our August 1996 review of Pentium notebooks were

- ▶ IBM ThinkPad 760ED
- ▶ Micron Millennia TransPort
- ▶ IBM ThinkPad 560
- ▶ AST Ascentia J50
- ▶ Austin Edge CD
- ▶ WinBook XP5 P100

See Second Looks (June 25, 1996) for details on getting the latest IR drivers.

Also from Toshiba is the Tecra 510 Series. Priced at \$5,100, the **Tecra 510 CDT** targets the corporate market and includes a 133-MHz Pentium, 16MB of EDO RAM, a 2.1GB removable hard disk, 2MB of EDO DRAM video memory, 16-bit Sound Blaster Pro-compatible sound, an integrated 28.8-Kbps fax modem with full-duplex speakerphone, and a 12.1-inch active-matrix display. The modular floppy disk drive can be swapped with the included 10X CD-ROM drive or with a second hard disk.

Not surprisingly, Hewlett-Packard (800-443-1254, www.hp.com), a leader in the creation of IrDA, offers FIR ports on its latest OmniBook series of lightweight notebooks. The \$4,370 **HP OmniBook 800CT 5/133 Model 1440**, which has a travel weight of just 5.4

pounds, offers a 133-MHz Pentium CPU, 16MB of RAM, a 1.4GB hard disk, 1MB of VRAM, on-board Sound Blaster-compatible audio, a 10.4-inch active-matrix SVGA display, and the OmniBook's integrated pop-out mouse. The \$3,050 **HP OmniBook 800CS 5/100 Model 810** comes with a 100-MHz Pentium CPU, a 772MB hard disk, and a 10-inch dual-scan SVGA display.

There's also the **NEC Versa 6000** series from NEC Computer Systems (800-388-8888, www.nec.com). Prices start at \$3,999 for a system with a 100-MHz Pentium CPU, 16MB of RAM, a 1GB hard disk, and an 11.3-inch SVGA active-matrix display. A 12.1-inch XVGA display is available with the higher-end \$5,399 133-MHz system, which also comes with a 1.4GB hard disk.—*RSA*



BOOK WORM: The Toshiba Portégé 660CDT and the HP OmniBook 800CT (far left).







IT'S AMAZING WHAT A LITTLE ACCESS TO MPEG VIDEO CAN DO TO A FORMERLY HUMBLE COMPUTER GUY.

Act I:

There's this PC user, Bob. Humble, hard-working guy. Creates presentations for his company. Could be sales, Web, computer-based training, whatever. But his presentations don't hit the right buttons. They don't connect. He loses out on sales. He's got to try to turn things around. He's got to do something dramatic. He decides to add video to liven up his presentations.

Act II:

Self-doubt sets in. Video's expensive. He's no Einstein, what if he can't work it? So he calls Data Translation for a free Broadway demo CD. Finds out it's got an intuitive interface, making capture and editing easy. It's got hardware-accelerated compression at 3X real time. It's got MPEG, the international standard for VHS quality video. Plus the thing's only \$995. Boom. Bob gets it.

Act III:

It's easy to install, works with what he's already got on his multimedia PC. Bob's adding video left and right. His boss is blown away. Sales go through the roof. Bob's a certified genius. His confidence soars. The attention goes right to his head. Bob thinks everything he touches turns to gold. Thanks to Broadway, Bob's right.



VIDEO CAPTURE.EDIT.COMPRESSION / WWW.B-WAY.COM

Minimum System Requirements: MPC-3 compatible system including a 90 MHz Pentium with one available half-size PCI slot, 16 MB RAM, Windows 95® or Windows NT™ operating system and Sound Blaster compatible audio card. ©1996 Data Translation, Inc. All rights reserved. Broadway is a trademark of Data Translation. All other names are the property of their respective holders.

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ANTIVIRUS

Protecting Your PC Against Internet-Borne Viruses

Antivirus software developers have shifted focus in recent months from detecting and removing viruses that arrive on your system via disk to finding and attacking those viruses that travel via the Internet and e-mail, as well as the increasingly prevalent application-based macro viruses. Such viruses now account for over half of all virus incidents.

Priced at \$995 for 50 users, **InterScan VirusWall** from Trend Micro Devices (800-228-5651, www.antivirus.com) serves as a firewall for Internet-borne viruses. Both InterScan and Trend's other new virus protection tool, **E-mail VirusWall** (\$695 for 50 users), scan uuencoded, MIME-encoded, and BinHex-encoded files, as well as files compressed using six popular compression formats, before the files can be opened. Trend's **ScanMail** (\$295 for 10 users) targets desktop users, detecting and notifying users about viruses found in VIM-based cc:Mail; support for MAPI mail clients and Lotus Notes is promised for the end of the year.

IBM Corp.'s \$49 **IBM AntiVirus, Version 2.5** (800-742-2493, www.brs.ibm.com), uses IBM's new "check on access" technology to scan files for viruses when they're being uploaded or downloaded. In contrast, TCT-ThunderByte Corp.'s \$49.95 **Anti-Virus for MS Exchange** (800-667-8228, www.thunderbyte.com) works with Microsoft Exchange and automatically deletes any incoming file attachment that's infected with a virus. Using Exchange's messaging model, the product also prevents users from sending corrupted attachments in outgoing Exchange mail.

Also battling viruses that travel via e-mail is **Cheyenne AntiVirus Agent** for Lotus Notes (\$695 per server), from Cheyenne Software (800-243-9462,

.com). Working in conjunction with Cheyenne's InocuLAN, AntiVirus Agent tracks viruses carried within Notes attachments and notifies users of any detected and removed viruses directly through Notes e-mail.

The \$49.95 **PC-cillin II**, from TouchStone Software (800-531-0450, www.checkit.com), introduces a Macro Shield feature that's billed by TouchStone as "personalized prescriptions" for your specific virus problems. There's also an Active Defense module for accessing online updates, virus news, and alerts.

Look Software Systems' \$29.95

Virus Alert (800-678-5511, www.look.com), takes the unique approach of working only with Microsoft Word (Versions 6.0 and 7.0). The software automatically scans each Word document

opened for macro viruses. It also gives Word users the option of deleting or keeping an unknown macro virus, to ensure that legitimate Word macros—which can

RECAP PC Magazine reviewed nine antivirus software products in the May 14, 1996 issue; our Editors' Choice was Norton AntiVirus for Windows 95. For a look at virus scanners that combat the Boza threat, see *New & Improved*, April 23, 1996. Trends recently visited IBM's Watson Research Lab to view the latest in scanning technology; you can read about it in our issue of April 9, 1996.

resemble macro viruses—remain intact and usable.

Norton AntiVirus Internet Scanner, from Symantec Corp. (800-441-7234, www.symantec.com), is being bundled with Netscape Communications Corp.'s \$29 **Netscape PowerPack 2.0 for Windows**, a collection of Navigator utilities that includes Netscape SmartMarks, Netscape Chat, and more. The virus scanner works as a plug-in with Navigator, Version 2.0 or later. For a more all-encompassing approach to virus protection, Symantec now offers separate Windows 95 and Windows NT versions of **Norton AntiVirus 2.0** (\$69.95 each). In addition to macro virus protection, both packages have a LiveUpdate feature for automatically refreshing the virus signature file that's stored locally via the Internet. The Windows NT version works on both servers and workstations.

McAfee's \$135 **Secure-1** (408-988-3832, www.mcafee.com) is a desktop security suite that packages VirusScan along with NetCrypto and WebCrypto. VirusScan detects and removes viruses, while NetCrypto protects network users' e-mail and WebCrypto enables anyone to send encrypted mail over the Internet.—Yvonne Koulouthros

DOCUMENT MANAGEMENT

Managing Your Documents

Impressive strides are being made in Internet—and intranet—document management software.

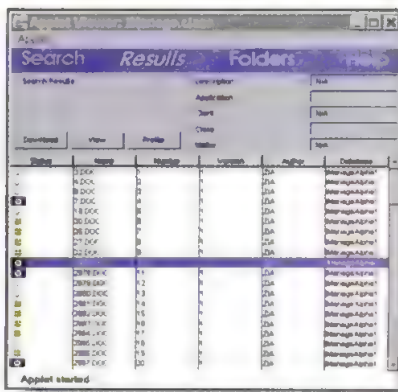
NetRight Technologies (408-

523-4000, www.netright.com) is offering **iManage Internet**, a Java-based tool that uses your Web browser as a universal

document management client. (Pricing was unavailable at press time.) The compact Java applets speedily download to the client system; once they're there, you can connect to the document management server on the host network. The applets work within

a secure environment that employs RSA encryption and a layered security model. You view documents in their native format using viewers that reside on the client system; or you can view documents in HTML format from within your Web browser.

Also integrating Internet functionality is **DOCS Open 3.0** (\$349 client, \$1,295 server) from PC DOCS (800-933-3627, www.pcdocs.com). DOCS Open 3.0 integrates DataRamp's Internet tool, which provides a secure pipe for ODBC data transactions over the Web. In addition, the software adds enhanced client/server document management abilities, Windows NT and NetWare support, configurable security, and a more powerful, Verity-based search engine.—Lance Ulanoff



BREWING DOCS: iManage's Java-based interface.

Trends Peripherals

TAPE STORAGE

Server-Level Tape Back-Up Technologies Push Ahead

The high-capacity tape storage market was never what you'd call fast-paced—until now. Three tape technologies are raising the bar on capacity and performance for server-level backup, with drives and cartridges delivering up to 25GB of uncompressed storage per tape.



At the lower end of the capacity spectrum, Tandberg Data (800-826-3237, www.tandberg.com) is now offering the \$2,749 **Tandberg MLR 1** tape subsystem. The MLR 1 employs the company's MLR (Multichannel Linear

Recording) technology to put 13GB of uncompressed data (26GB with compression) onto \$69.95 MLR tapes—a fivefold increase over previous QIC capacity. Tandberg claims the unit has a 3-Mbps transfer rate. The drives are backward-compatible with QIC tapes.

Sony Electronics (800-326-9551) doubles that capacity with its new 8-mm technology, SDX. SDX is featured in Sony's \$4,995 **SDX-300C** drive. Although not backward-compatible with older 8-mm tapes, the new system packs 25GB of data (60GB compressed) onto the \$99 cartridges. At 3 MBps, the transfer rate achieved by SDX matches that of Tandberg's MLR technology. Sony's unique Memory in Cassette (MIC) feature puts a memory chip in the cartridge that holds an index of the tape's contents, which should reduce seek times noticeably.



HIGH-CAPACITY STORAGE: The Tandberg MLR 1 (above) and the HP SureStore DLT30e (left).

ably. Current tape designs put the index at the beginning of the tape, so the drive must first rewind to the beginning before going to the desired data; by contrast, MIC makes the data available for scanning at all times.

Hewlett-Packard Co. (800-826-4111, www.hp.com) joins the fray with its **HP SureStore DLT30e** and **DLT40e**. With prices starting at \$4,545, these drives are based on Quantum's digital linear tape technology. Cartridges—\$87 for the DLT30e, \$185 for the DLT40e—can hold 15GB to 20GB of uncompressed data.

Farther out on the horizon are DAT solutions from Hewlett-Packard, Seagate, and Sony code-named DDS-3.—*Jamie Bsaes*

DISK STORAGE

Your Next Floppy?

The fight for the future of the floppy disk drive has begun. The LS-120 drive, developed by Compaq Computer Corp., OR Technology, 3M Data Storage Products, and drive giant Matsushita Kubotoko Electronics, puts 120MB of data on a 3.5-inch disk; the drive can also read existing 3.5-inch floppy disks and act as the system's boot drive. Compaq's Deskpro line of PCs now ships with the LS-120 floppy disk drive.

OR Technology's \$210 **a:drive** (408-866-3000) upgrades the drive with a 1-inch-high LS-120 drive that you can install as a replacement for your system's standard floppy disk drive. In order to use the drive, you need Promise Technology's \$49 **Floppy-MAX**, a bootable, plug-and-play ATAPI controller that fits in a standard 16-bit ISA slot and delivers BIOS support for the new drive (408-452-0948).—*JB*

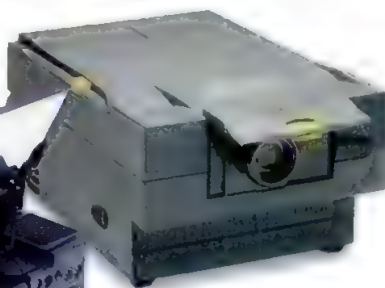


LCD PROJECTORS

A Sharper Image

Computer-based multimedia presentations are taking over corporate boardrooms, and makers of LCD projectors are jockeying for position. The current hotbed of activity is in the 15-pound ultraportable projectors arena. Wowed by the success of the 10-pound \$4,995 **Viewpoint 100** from Lightware (800-445-

9316), other projector makers are introducing lightweight compact units targeted at mobile salespeople, marketing executives, and training professionals.



POP-UP PROJECTORS: The cleverly designed In Focus LiteGo 320 (left) and Proxima Lightbook collapse for easy portability.

The \$4,999 **Lightbook** multimedia projector, from Proxima Corp. (800-447-7692, www.prxm.com), is an 11-pound SVGA unit that's about the size of two stacked notebook computers. Rated at 250 ANSI lumens, the projector can create an image anywhere from 4 to 14 feet in size (measured diagonally). The system has a carrying case and Proxima's Cyclops infrared hand-held remote control, which gives you full cursor control of your PC and the projector's special effects from anywhere in the room.

In Focus Systems' lightweight **LiteGo 320** will sell for about \$6,500 (800-294-6400, www.infocus.com). This 9-pound SVGA multimedia projector folds up to just 3 inches thick. The LiteGo 320 comes with a carrying case that can hold your notebook as well, so you need to carry only one bag. Like the Lightbook, the LiteGo 320 is rated at 250 ANSI lumens and comes with a remote.

Sanyo Corp. (818-998-7322) is getting into the portable-projector act with its \$9,995 **Sanyo PCL-5500N**. This SVGA projector is larger and heavier than the others, but according to Sanyo it delivers 400 ANSI lumens, which would make it the brightest projector in this class.—*JB*

RECAP In our August 1996 roundup of portable peripherals, our Editors' Choice was the Lightware Viewpoint 100.

You can take a look at the next generation of data projectors with the First Looks review of the first DLP projector—in Focus Systems' LitePro 620—in our issue of October 8, 1996.



**WITH DESKTOP SYSTEMS THAT PUT OUT
THEIR OWN FIRES, YOU DON'T HAVE TO COME TO WORK
WEARING THE SAME OLD SUIT EVERYDAY.**



The next time there's a five-alarm fire at the office, sit back and relax. With the new PowerMate® Series from NEC, you can manage the entire network without leaving your desk.

The fact is, exclusive NEC MagicEye™ technology monitors the function and operation of each PowerMate system, including its hard drive activity, temperature and voltage. It'll even alert you if a computer is tampered with. If a problem is detected, Intel's LANDesk® Client Manager 3.0 lets you remotely access the system for efficient, centralized management. What's more, Cybermedia's FirstAid 95 Deluxe automatically fixes configuration errors and, along with McAfee's anti-virus software, protects your valuable data.

Alone, the PowerMate desktop computer can be anything from a general office PC to a powerful corporate workstation. Linked together, they're a sophisticated network that you can remotely manage.

Granted, you may still have to put out an occasional fire. But at least now you can do it in everyday business attire. For more information, call 1-800-NEC-INFO, or visit us on the web at <http://www.nec.com>.

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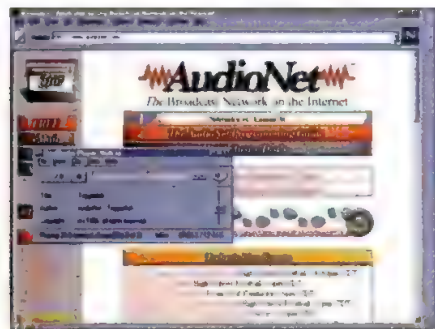
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CIRCLE 155 ON READER SERVICE CARD

AUDIO

Listen Up On the Web

Thanks to the combination of large, cumbersome files, poor sound quality, and multiple incompatible formats, Web-delivered audio has so far remained a novelty. By addressing these issues—albeit with different approaches—the following



LIVE AUDIO STREAM: RealAudio 3.0.

audio products hope to bring enhanced Web sound to a PC near you soon.

Progressive Networks' popular **RealAudio 3.0** (206-674-2700, www.realaudio.com) improves on the program's ability to

stream sound on the Internet. The newest version—available for free at Progressive Networks' Web site—supports the delivery of stereo sound across 28.8-Kbps modem connections, or near-CD-quality sound across an ISDN and network connections. The PerfectPlay feature creates a buffer on the system's local drive to enhance performance with slower or less reliable connections.

RealAudio already boasts over 100 radio stations worldwide that are streaming live, 24-hour broadcasts to the Web. To help you tune in these various RealAudio "channels," Progressive Networks is now offering the \$30 **RealAudio Player Plus**, the commercial version of the RealAudio player. The software includes preset buttons for instant access to your favorite stations, scanning across indexed radio stations, and the ability to listen to downloaded material off-line.

A longtime staple for music



professionals, MIDI (Musical Instrument Digital Interface) has had a rocky transition to the Web. Although a wealth of MIDI resources are available, no browser solution has yet been able to capture MIDI's full potential.

Yamaha's free downloadable Netscape Navigator plug-in, **MidPlug** (www.ysba.com/midplug_index.html), promises to change that. MidPlug's built-in Soft Synthesizer is able to render full-stereo versions of 128 General MIDI instruments, 8 drum kits, and digital reverb. In addition to the standard playback functions, there

RECAP PC Magazine reviewed five streaming audio technologies (March 26, 1996) and awarded Editors' Choices to

- RealAudio 2.0
- TrueSpeech Internet

We reviewed the top 30 helper applications and Netscape Navigator plug-ins in the May 14, 1996, issue.

are controls for adjusting the overall tempo and pitch of a MIDI file.

Promising to deliver CD-quality audio to the Web is Liquid Audio's new suite of professional applications covering all aspects of Internet music (415-562-0880; www.liquidaudio.com). The \$295 **Liquidifier** allows for the editing and mastering of audio materials. Album-length files can then be compressed and updated in a format that the company claims supports CD-quality audio over 28.8-Kbps connections. A free standalone helper application, **Liquid Audio Player**, should be available for download by the time you read this. The planned retail version of the player will utilize registration information to facilitate transactions at commercial record sites and allow you to record an audio CD of downloaded material.

Placing you in the music publishing business is the **Liquid Audio Music Server**, which is due early next year and is expected to sell for around \$1,500. You can use the server to broadcast CD-quality music from Unix or Windows NT server platforms.—*Andrew Boscardin*

DISCUSSION SOFTWARE

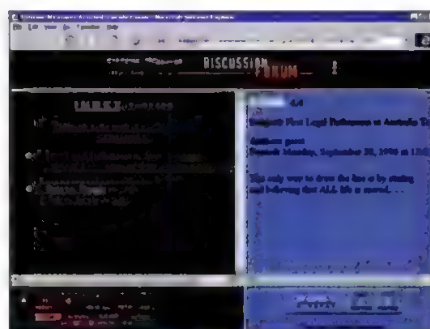
Picking Up the Thread

Threaded discussion software for the Web is moving away from presenting endless, boring pages of posted messages and is embracing the news-reader metaphor that's become the accepted norm for viewing the action on Usenet newsgroups. Showcasing what Webmasters can do to add cutting-edge discussion forums to their sites are new packages from Proximcom and DigitalFacades.

RECAP Group discussion software was last reviewed in the issue of April 23, 1996. An Editors' Choice was awarded to Workgroup Web Forum.

Proximcom's **Podium 2.1** (www.proximcom.com), available for HP, Linux, SGI, Sun, and Unix servers is capable of working with a variety of situations. Pricing depends on the number of forums and site licenses required and starts at \$5,000 for a 10-forum configuration. By contrast, DigitalFacades' **Xpound! HT** (www.xpound.com) is currently available only for Windows NT and Unix servers. Xpound! is priced at \$499 with an unlimited number of forums; a trial version can be downloaded from the company's Web site.

Both offer frames-based, customizable interfaces that have many of the features you'd expect



CUSTOMIZED FORUMS: Xpound! HT.

to see in a news reader, such as expanding and collapsing threads, organizing posts by date, and the ability to modify messages after they're posted. Podium and Xpound! also have extensive forum management tools that can handle setting the rights for different groups of users and providing control over deleting messages.

Another common feature is the ability to conduct searches through threaded discussions. Xpound! lets you conduct full-text, case-sensitive searches across both entire forums and all threads contained therein, in addition to searching for a specific author using Boolean operators. Podium lacks

Xpound!'s advanced search functions but does support searching across forums.

For examples of Podium and Xpound! in action, visit ZD Net University (www.zdu.com/zdulive/catalog/tour.htm) and Lynx Golf (www.lynxgolf.com/chat.html), respectively.—*David Lidsky*

ROAD WARRIOR ALERT



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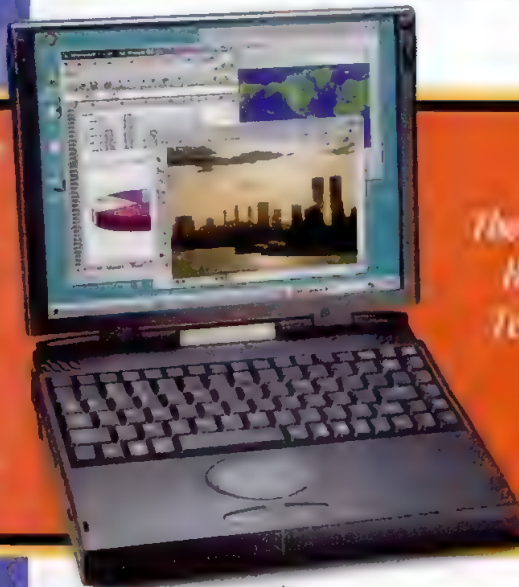
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GROUPWARE

The Internet's Group Ethic

In an effort to adapt to the pull of the intranet, the latest releases of the major groupware systems have added a variety of Internet connections and Web protocols.

Expected by year's end, Lotus Development Corp.'s **Lotus Notes, Release 4.5** (800-346-1305, www.lotus.com), will include Domino, Lotus's server software for publishing Notes databases in HTML format. (Prices range from \$55 for the Notes Mail Client to \$495 for the single-processor server.) Upgraded to Release 1.5, Domino features Secure Sockets Layer 3.0 for enhanced transaction security; support for ActiveX components; improved Web construction tools and sitewide searching; and a way to view your calendar and scheduler through any HTML 1.0-compliant Web browser.

Notes' Web browser—the Personal Web Navigator—has also

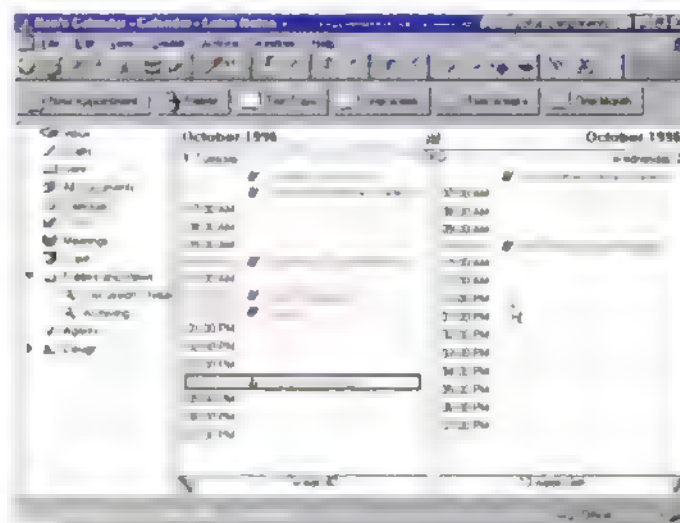
been revamped. The browser no longer requires a Notes server to browse the Web; instead you can now browse directly from the client. Personal Web Navigator also supports Navigator plug-ins and HTML 3.2 formatting, although it doesn't support such HTML extensions as the viewing of frames.

Microsoft Corp.'s **Microsoft Exchange 4.5** (800-426-9400, www.microsoft.com) has its own method of integrating with the Internet. (Pricing was unavailable at press time.) Thanks to Exchange 4.5's native support for POP3 mail and news-

RECAP PC Magazine last reviewed groupware in the October 8, 1996, issue; our Editors' Choice was Lotus Notes, Release 4.1.

You can find our review of Domino in First Looks, October 22, 1996.

groups, Exchange users are now able to get e-mail using a POP3 e-mail client and access Exchange databases through a news reader. There's also native support for the Lightweight Directory Access Protocol (LDAP), a directory structure embraced by many messaging software vendors, including Netscape and Novell.



MAKE A DATE: Lotus Notes 4.5's calendar.

Another new Exchange component is the Outlook client, which provides more powerful workflow and desktop information management tools.

Novell's latest entry in the

groupware arena, **GroupWise 5** (800-638-9273, www.novell.com), concentrates on an updated client/server messaging architecture. (Prices range from \$1,421 for 10 users to \$32,625 for 250 users.) As with GroupWise 4, the free downloadable WebAccess mod-

ule lets you access a GroupWise mailbox with any Web browser. GroupWise 5 features integrated document management, but the next revision will add more versioning and workflow capabilities.

Netscape has released a \$995 Catalog Server for its **SuiteSpot** Web server package (415-937-2555, www.netscape.com). It provides indexing, browsing, and searching of the content and services on an intranet. Look for next year's extended rollout of the next version of SuiteSpot, code-named Orion. —David R. Lambert

PC CARD MODEMS

Faster Mobile Connections

Road warriors, take heart: Top-speed 33.6-Kbps PC Card modems have arrived.

Motorola Mobile Computing Products Division (800-427-2624, www.mot.com) has introduced the \$309 **Montana** PC Card fax modem, which provides 33.6-Kbps data and 14.4-Kbps fax transmissions. If you also need to plug into your network, then consider the \$399 **Mariner**, which adds either a

10Base-T or a 10Base2 LAN adapter to the Montana's modem capabilities. Motorola offers a \$50 trade-in for those who own the 28.8-Kbps version of either modem, or you can get a \$100 rebate on your 33.6-Kbps PC Card purchase.

ActionTec (800-797-7001, www.actiontec.com) has analog and cellular models of its \$239 **DataLink PC Card 33.6** fax modem. Also from ActionTec is the \$479 **ComNet 33.6**, a combination 10Base-T or 10Base2 LAN adapter and fax modem.

Xircom (800-438-4526, www.xircom.com) also offers two models of its 33.6-Kbps modems: the \$259 **CreditCard Modem 33.6**; and the \$359 **CreditCard Ethernet+Mo-**

dem 33.6, which includes a 10Base-T interface. Another modem with a 10Base-T network card is Silicom Connectivity Solutions' \$445 **EtherModem** (800-474-5426, www.silicom.wa.com/silicom/).

TDK Systems' \$349 33.6-Kbps **TDK DataVoice 3400** (800-999-4835, www.tdk.com) in-

allows you to use you modem as a speakerphone in your audio-enabled notebook.

Hayes' **Optima 288** \$289 PC Card modem (800-723-8388, www.hayes.com) can be upgraded by downloading a file from Hayes' Web site. Optima cards produced before January 1996



cludes Radish VoiceView technology, which facilitates alternating between talking on the phone and working with data during a call. For users of the 28.8-Kbps model, a flash upgrade is available from TDK's BBS (916-265-8271). Also from TDK is the new \$249 **TDK Cyber-Express 3000**, a 33.6-Kbps, full-duplex PC Card fax modem that

may not be upgradable. In that case, you may need to trade in your old card to reach top data speeds; the charge for a trade-in is \$139. A free flash upgrade for Simple Technology's \$249 28.8-Kbps **Communicator** data fax PC Card modem is available from the company's Web site (800-474-6753, www.simpletech.com). —DRL

RECAP For a roundup of 33.6-Kbps external modems, see the First Looks review in this issue.

In our roundup of portable peripherals (August 1996), we looked at 28.8-Kbps Ethernet PC Card modems and awarded Editors' Choices to

- Motorola Marquis
- 3Com EtherLink III LAN+Modem PC Card

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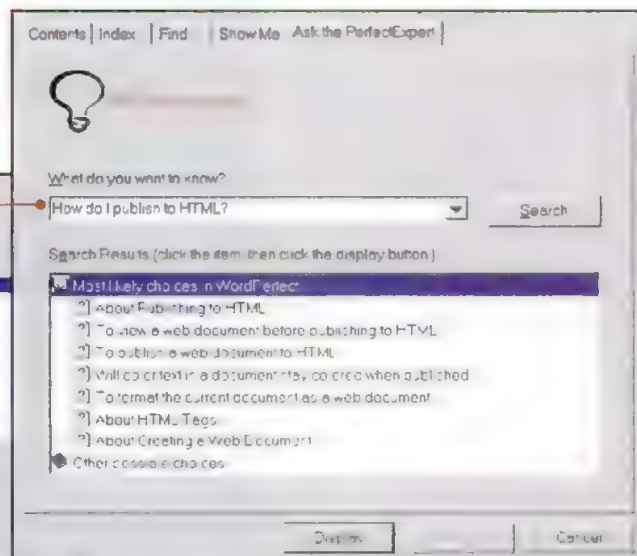
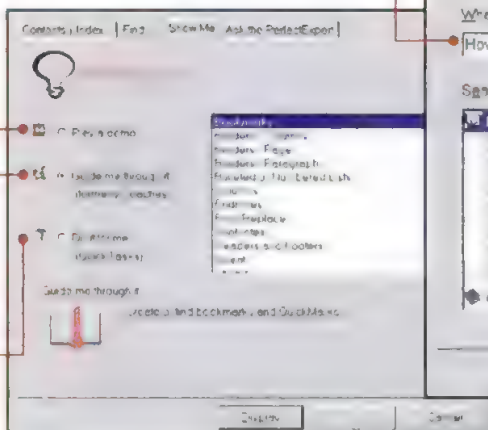


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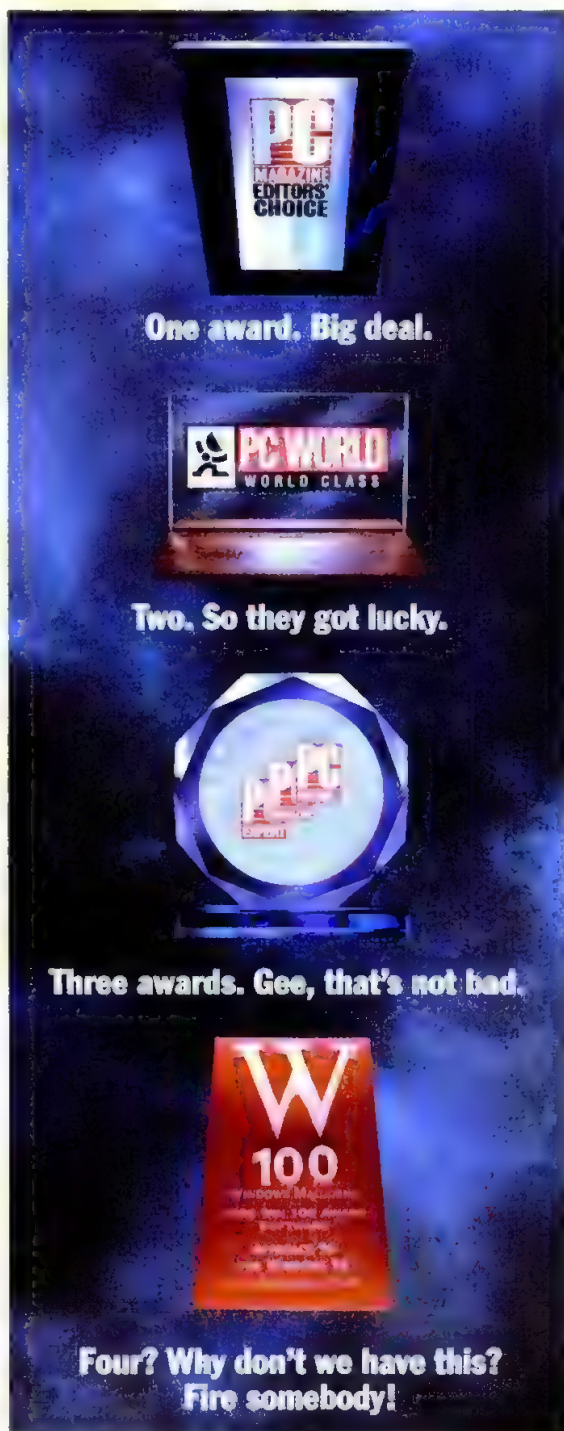
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First Looks

Data in the Fast Lane

Five 33.6-Kbps modems that can move data in a flash.—By William P. Flanagan

Lets face it, just about everyone these days has online access. Whether you use it to connect to the Internet, a traditional online service, or your company's network after hours, what matters is how wide the pipe is that funnels data to and from your PC. The bad news is

many navigate the Web quicker, send faxes faster, and get their homework done earlier.

Having a 33.6-Kbps modem on one end of the data conversation is meaningless, because you have to drop down to the better common speed of the two modems. As a result, the advantages

Kbps for those who currently own V.34 modems is minimal. Many modem makers are offering upgrades for a nominal fee or as a free download from their electronic bulletin boards or Web sites. In addition, many are also offering PC Card modems capable of 33.6-Kbps throughput; for a rundown on upgrades, see Trends/Networking on page 42 in this issue.

Still, some vendors are expected to hold out until next year's expected advent of 56-Kbps communications, a 67 percent improvement over these 33.6-Kbps modems. There are competing standards for 56-Kbps data throughput from Lucent Technologies—formerly AT&T Bell Labs—and Rockwell, the makers of the majority of chip sets for this group of modems. The common element is that they're both based on asynchronous connections, which receive at 56-Kbps but send at a lower rate.

Which standard will prevail? It's anyone's guess at this point, but because the Microsoft Network and America Online have endorsed the Rockwell approach, it seems to have the early lead. These devices are expected to work with digital phone connections between phone companies and ISPs, online service providers, and corporate networks.

The products included in this roundup are among the first external modems with the capability to communicate over standard phone lines at speeds of up to 33.6 Kbps. We included Boca Research's Boca MV34E, Cardinal

SPEED DEMONS: The five modems offer a swift 33.6-Kbps data transfer rate, but they vary in price and the features they offer. Clockwise from the top are the U.S. Robotics Sportster 33.6 Faxmodem, Cardinal MVPV-34XE, Boca MV34E, Diamond Supra-Express 336e, and Zoom V34X Plus.

that if you're not one of the lucky few who can get an ISDN line in your home or tap into your company's T1 connection, then you'll have to get by with an analog modem and the public telephone network. The good news is that the newest modems just got quite a bit faster.

The latest high-speed modems, which meet the recently completed, enhanced V.34 standard, have made the leap to 33.6 Kbps. This 17 percent improvement in top throughput over 28.8-Kbps modems will help

comparable 28.8-Kbps units, getting one of these fast modems is a win-win proposition. Expect to see a wide variety of external 33.6-Kbps modems available for under \$200 and some internal models for about \$100.

The cost of upgrading to 33.6

INSIDE

COMPAQ PRESARIO 3020:

Compaq's innovative home PC packs a lot of power in a portable box. See Page 54 for the review.

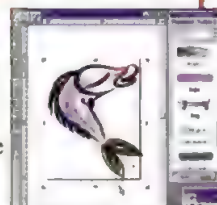


BUSINESSMAP 2.0: The easier way to get a geographical perspective on your business data. See Page 66.



FRactal Design EXPRESSION:

Vector-based illustration software that lets you flex your creative muscles. See the review on Page 64.



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ZipFolders 1.0	...76

First Looks Online Go online December 2 to 6 to discuss

33.6-Kbps modems with our editors and industry representatives.
www.pcmag.com/discuss.htm



First Looks

Editors' Choice

• U.S. Robotics Sportster 33.6 Faxmodem



Getting data from here to there reliably requires a modem that puts several disparate functions together. A good high-speed modem needs to be able to get the most out of

the current modulation specification, handle noisy telephone lines, work with a wide variety of file types with fidelity, and utilize the latest features that the phone networks offer. The \$180 U.S. Robotics Sportster 33.6 Faxmodem offers all that and includes the best mix of software we've seen in a modem. It's our Editors' Choice for the first group of 33.6-Kbps modems to hit the market.

The Sportster touches all the bases. On both our performance tests, it turned in the best throughput of the five modems we looked at. U.S. Robotics was the only vendor to offer toll-free technical support for customers with problems, and as a bonus, the Sportster supports caller ID and distinctive rings. Our only qualm comes from the modem's disappointing compatibility score, but in our experience, this device made

quick and reliable connections. If modem speed and the latest features are paramount, the Sportster 33.6 Faxmodem is for you.

The others modems were capable but less well rounded. The \$319 Boca MV34E was the



highest-priced modem we looked at, but it didn't include the bells and whistles we expected. The \$154 Cardinal MVPV34XF was the only one to include a lifetime guarantee and be upgradable via flash memory. Of the two low-priced devices in this group, the Diamond SupraExpress 336e's intriguing \$129 price tag was illusory: It lagged behind the others in terms of performance and features and doesn't even have a power switch. The \$139 Zoom V34X Plus, which had the most complete assortment of indicator lights, is the better choice if cost is a primary factor.

press 336e's intriguing \$129 price tag was illusory: It lagged behind the others in terms of performance and features and doesn't even have a power switch. The \$139 Zoom V34X Plus, which had the most complete assortment of indicator lights, is the better choice if cost is a primary factor.

Technologies' Cardinal MVPV34XF, Diamond Multimedia's SupraExpress 336e, U.S. Robotics' Sportster 33.6 Faxmodem, and Zoom Telephonics' Zoom V34X Plus. Ranging in price from \$130 to \$320, these modems are not only fast, but some are inexpensive as well.

As expected, these modems have lot in common. Each was able to get up to full speed on

our tests quickly, send and receive faxes, and handle the major error-control protocols (V.42 and MNP 2-4) and data-compression command sets (V.42bis and MNP 5). They each maintain compatibility with older—but still popular—modulation protocols, right down to 2,400-bps throughput.

Apart from their individual performance profiles and differ-

ent designs, each of these five modems offer a unique combination of equipment, features, software, and level of technical support. For example, of the five, only the Cardinal MVPV34XF could have its firmware upgraded via a flash memory chip. This means that as updates become available, the other four won't be able to adapt easily.

More than ever, technical support can be the difference between frustration and freedom in cyberspace. Of the five vendors, only U.S. Robotics offers a toll-free number for its users, and only Cardinal includes a lifetime warranty. Two companies, Diamond Multimedia and Boca Research, included serial cables with their products; the other three do not. This may seem like a small nit to

pick, but not including a \$5 cable can be either a mild annoyance (if you already have a serial cable and just need to find it) or a major nuisance (if you have to go back to the store to buy one).

Of the five modems, only the products from U.S. Robotics and Zoom supported both distinctive ring and caller ID; the Cardinal modem works with caller ID. This pair of features can be useful for home or small-office users who want to connect several devices to a single phone line or know who's on the line before answering the call.

To put these modems through their paces, we simulated real-world use with a pair of performance tests: Throughput vs. File Type, which measures a modem's ability to transfer a wide variety of file types, and Telephone-Network Simulation, which measures how well a modem functions over a variety of line conditions typical in the public switched telephone network. This latter test is important because poor line connections often keep modems from running at full speed.

Compatibility is less of a problem today than it was five or ten years ago, yet only the Diamond SupraExpress and the Zoom V34X Plus connected completely to our test-bed.

Performance differences among the five modems were significant; the Sportster was the speed demon of the bunch. The 20 percent throughput difference between the fastest modem and the slowest could mean extra minutes downloading a multi-megabyte file or a few seconds waiting for a fax to be sent.

Each of these five modems will be able to satisfy your basic data-moving needs. If you need to keep to a strict budget, check out the \$140 Zoom V34X Plus. But if you have the need for speed, the \$180 U.S. Robotics Sportster 33.6 Faxmodem was not only our top performer but our value choice as well.



Boca MV34E
Street price: \$320
Requires: PC serial port
Boca Research Inc., Boca Raton, FL
951-987-6227, 407-964-5848
www.bocaresearch.com
Circle 412 on reader service card

HIGH BUDGET: The most expensive of the five modems, the Boca MV34E provides good connectivity.

Boca Research Inc.

Boca MV.34E

Based on what it provides and its performance, it's hard to justify the \$320 price tag on the Boca MV.34E; it was by far the highest-priced modem in this roundup. Its performance was consistent but unspectacular, and the included software was run-of-the-mill.

The MV.34E comes in basic black and has an angled front panel with eight LED indicators that show what's going on during a call; but there's no speed indicator or alphanumeric display.

Like most modems here, the MV.34E is based on a Rockwell chip set and a Rockwell signal converter. The modem supports the major error-control and data-compression command sets, and is compatible with Group 3 fax, offering full support of Class 1 and 2 fax standards. Surprisingly for a high-priced modem, the MV.34E doesn't support distinctive ring or caller ID.

Setup was eased by the inclusion of a serial cable and by

Boca's comprehensive set-up guide, which walked us through the configuration process. The software bundle included online service starter kits from America Online and CompuServe, and ISP offerings from Global Network Navigator and NetCom; the modem also comes with FaxWorks for Windows.

On performance tests, the MV.34E proved to be a middle-of-the-road performer, taking third place on both tests. The MV.34E proved itself a versatile but not perfect modem on modem compatibility tests.

Boca has a Web site as well as a BBS for firmware upgrades, but if your modem doesn't connect you'll need personal help, which means making a toll call between the hours of 8:00 and 6:30 (eastern time). You have instant access through a 900-number to a senior technician, but the call costs \$2 per minute.

In brief, the \$320 Boca MV.34E was an average performer that carries a high price tag.



Cardinal MVPV34XF

Street price: \$160

Requires: PC serial port

Cardinal Technologies Inc., Lancaster, PA

800-775-0886, 717-2283-3080

www.cardtech.com

Circle 413 on reader service card

LIFE: The lifetime warranty on the Cardinal MVPV34XF makes it a keeper.

Cardinal Technologies Inc.

Cardinal MVPV34XF

The Cardinal MVPV34XF won't win any awards for industrial design, but its boxy case houses a midrange modem with a lifetime guarantee that costs \$160.

With the exception of the irritating omission of a serial cable, setup was easy and trouble-free. Cardinal includes a setup guide designed to help the novice get started. The MVPV34X is based on a Rockwell chip set and signal converter. The unit lacks both an alphanumeric display and a

speed indicator, but it has eight LED indicator lights so the user won't be totally in the dark about the modem's status. Inside the manual, you'll find explanations of the indicators' cryptic front-panel abbreviations.

The MVPV34XF is a Group 3-compatible modem that supports Class 1 and 2 fax machines. It also supports all major error-control and data-compression command sets. Of the five modems we looked at, the MVPV34XF was the only one to use flash memory to store its firmware, which makes it the most upgradable

PERFORMANCE TESTS

External 33.6-Kbps Modems



The U.S. Robotics Sportster 33.6 Faxmodem was the clear winner among this group of 33.6-Kbps modems. On the Throughput vs. File Type and Telephone-Network Simulation tests, the Sportster edged out

the Cardinal MVPV34XF, with the Boca MV.34E and the Zoom V.34X Plus close on their heels. On both tests, the difference in throughput between the best and the worst modems was about 20 percent.

	Throughput vs. File Type		Telephone-Network Simulation	
	Characters per second		Characters per second	
Boca MV.34E	6,334		3,167	98
Cardinal MVPV34XF	6,101		3,202	95
Diamond SupraExpress 336e	5,324		2,650	100
U.S. Robotics Sportster 33.6 Faxmodem	6,718		3,402	21
Zoom V.34X Plus	5,972		3,142	100

HOW WE TESTED

To give these 33.6-Kbps modems a good workout, we based our test procedures on the EIA/TIA Telecommunications Systems Bulletin TSB-38. The Throughput vs. File Type test measures a modem's ability to transfer a variety of file types. The Telephone-Network Simulation test measures how well a modem functions under line conditions you are most likely to

encounter in the public switched telephone network (PSTN). In each case, we sent and received actual bits of data to and from the modems.

In addition, we tested each unit for compatibility with a U.S. Robotics Courier V. Everything, which is used by many ISPs and online service providers, and with an additional Diamond SupraExpress 336e; each modem's results on this test are presented as a

percentage of the best results we encountered.

Our test-bed consisted of a Dell 433ME with 8MB of RAM, a Hayes Enhanced Serial Port board, and a Telecom Analysis Simulator. This system simulates actual telephone lines, complete with typical line problems. Our tests use 168 different line conditions, representing 100 percent of the EIA/TIA's model for the U.S.

First Looks

modem of the bunch. The modem supports distinctive ring, but not caller ID. Cardinal included all the software titles one would expect: online service startup kits from America Online and CompuServe, and Internet connections from Global Network Navigator; FaxTalk for Windows is also included.

On both our performance tests, the MVPV34XF posted results that trailed those of the U.S. Robotics Sportster 33.6 Faxmodem. On the Throughput vs. File Type test, the system's score was above average, which means it can handle the transfer of a good variety of file types without choking. Its score for the Telephone-Network Simulation tests was above average as well. The Modem Compatibility test showed the MVPV-34XF to have good compatibility with our test-bed.

When it comes to service and support, Cardinal's lifetime coverage of the MVPV34XF puts this modem in a class by itself. Technical support is available from 8:00 to 8:00. (eastern time) but requires a toll call.

While there are modems in this roundup that offer better

performance, more visually pleasing designs, and more complete software bundles, the Cardinal MVPV34XF's low price tag and lifetime warranty make it attractive.

Diamond Multimedia Systems Inc.

SupraExpress 336e

At \$130, the Diamond SupraExpress 336e is the least expensive modem in this roundup. But buying it may be penny-wise and pound-foolish. If you're prepared to pay \$10 more, you'll do better with the Zoom V.34X Plus.

The SupraExpress has no quick setup guide and no reference material other than a manual. The only attractive feature of getting the SupraExpress up and running is the inclusion of a serial cable.

We found the unit lacking in the most unexpected places. There was no power button or volume control, and there are only four LEDs, none of which indicate connection speed. In addition, the modem doesn't have flash

memory for storing firmware and supports neither caller ID nor distinctive ring.

The included software equals that offered by the other modems in this roundup: online startup kits from America Online, CompuServe, and NetCom. As a bonus, Diamond includes VDOnet, a videoconferencing package, and 5 free hours to try it out. The package also includes FaxTalk Plus.

The SupraExpress's performance lagged behind the oth-

er Network Simulation test, which means unfavorable line conditions can cause problems with data transmission. The SupraExpress's one performance strong point was on the Modem Compatibility test, where it was one of only two modems to show 100 percent compatibility with our test-bed.

Diamond's service and support is available from 8:00 to 10:00 Monday through Friday and from 11:00 to 7:00 on Saturday. Diamond doesn't offer



SupraExpress 336e

Street price: \$130

Requires: PC serial port

Diamond Multimedia Systems Inc.

San Jose, CA; 800-727-5772, 408-804-1488

www.diamondmm.com

Circle 414 on reader service card.

LOW BALL: The Diamond SupraExpress 336e is the least expensive of these five modems, but it cuts too many corners.

ers. Its Throughput vs. File Type test numbers were the lowest of this group, which means the modem had difficulty in the transfer of different file types. It also brought up the rear on the Telephone-

toll-free access to tech support, but there is a Web site and an electronic bulletin board for frequently asked questions, basic support, and upgrades.

Although the price may be attractive, it's hard to recommend the Diamond SupraExpress 336e. Our advice is to spend a little more and get a more well-rounded modem.

U.S. Robotics Inc.

Sportster 33.6 Faxmodem



The \$180 Sportster 33.6 Faxmodem from U.S. Robotics puts it all together in a design that offers the best mix of performance,

features, and price.

The Sportster comes with an excellent setup guide that communications novices will find especially helpful. The package didn't include a serial cable, however, so keep that in

33.6-Kbps Modems: Side by Side

✓ YES ✗ NO

In alphabetical order by company.

Red type denotes Editors' Choice

	Boca MV.34E	Cardinal MVPV34XF	Diamond SupraExpress 336e	U.S. Robotics Sportster 33.6Faxmodem	Zoom V.34X Plus
Street price	\$320	\$180	\$130	\$180	\$140
Dimensions (HWD, in inches)	1.0 x 5.3 x 7.3	1.5 x 5.0 x 5.3	1.0 x 4.0 x 6.0	1.3 x 6.5 x 3.8	1.3 x 5.0 x 6.0
Controller	Rockwell 63903-57	Rockwell 139903-57	Rockwell 13903-57	USR custom chip	Rockwell 6903-57
Signal converter	Rockwell RC288DPI 6682-24	Rockwell RC288DPI 6682-26	Rockwell RC288DPI 6682-26	Texas Instruments/USR DSPcode	Rockwell RC288DPI R6682-26
Supports flash memory	✗	✓	✗	✗	✗
Supports caller ID/distinctive ring	✗ ✗	✗ ✓	✗ ✗	✓ ✓	✓ ✓
Location of power switch	Back	Back	N/A	Front	Front
Location of volume control	N/A	N/A	N/A	Side	N/A
Number of status indicators	8	8	4	7	14
Speed indicator	✗	✗	✗	✗	✓
Includes phone cable/serial cable	✓ ✓	✓ ✗	✓ ✓	✓ ✗	✓ ✗
Supports V.22bis, V.32, V.32bis, V.34, V.FC	✓	✓	✓	✓	✓
Error-control command sets	V.42, MNP 2-4	V.42, MNP 2-4	V.42, MNP 2-4	V.42, MNP 2-4	V.42, MNP 2-4, MNP 10EC
Data-compression command sets	V.42bis, MNP 5	V.42bis, MNP 5	V.42bis, MNP 5	V.42bis, MNP 5	V.42bis, MNP 5
Warranty	5 years	Lifetime	5 years	5 years	7 years

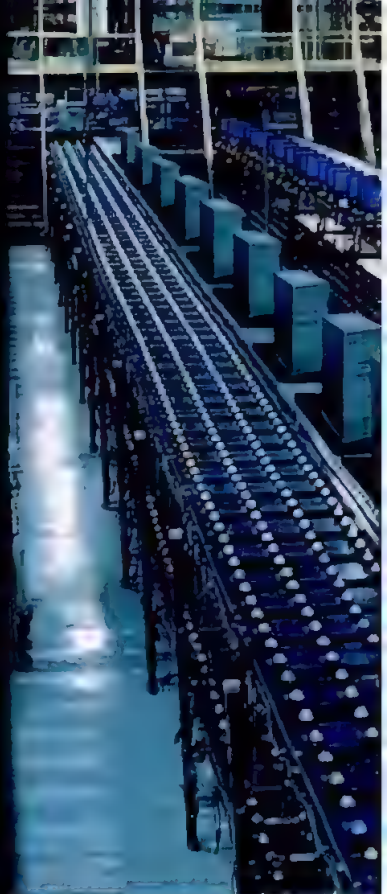
N/A—Not applicable. The product does not have this feature.

LOOKING FOR THE BEST PCs ON THE MARKET?

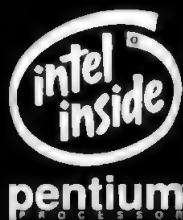


MICRONTM
ELECTRONICS, INC.



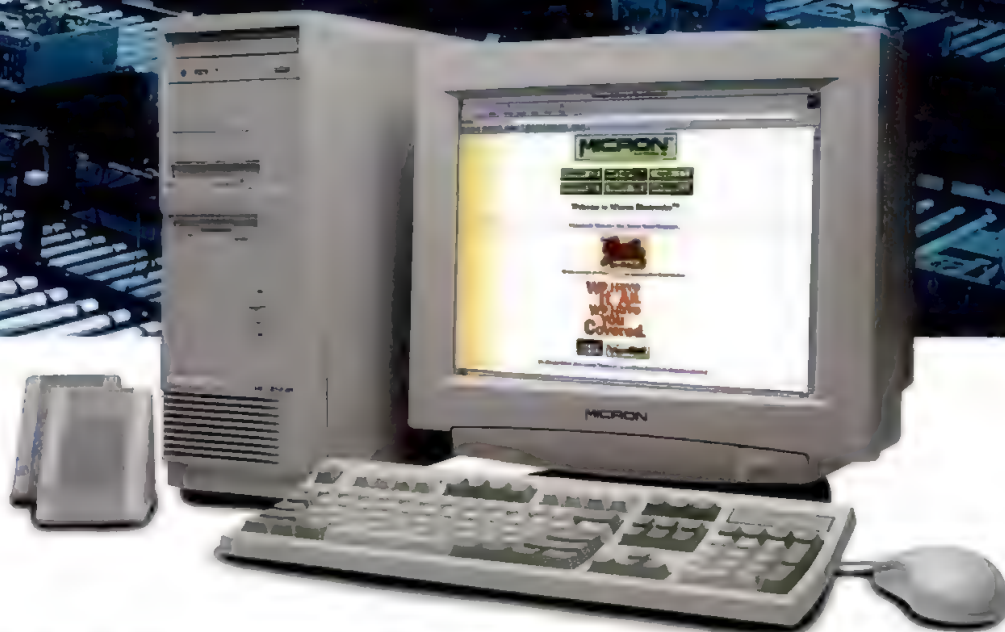


WHAT A COINCIDENCE, WE HAPPEN TO MAKE THEM.



NOW YOU GET TWICE THE MEMORY IN SELECTED
SYSTEMS! (SEE CONFIGURATIONS)

Micron Electronics brings high-tech manufacturing to the PC factory floor. Recently we've invested millions of dollars to build the most advanced PC manufacturing facility possible.



Outstanding Performance—Don't Take Our Word for It.

Talk is cheap when you're speaking for yourself. But when it's from the mouth of an industry expert, it carries weight. Here are a few of many examples of what they're saying about our PCs:

- **Home MPC** "... the fastest we've ever tested ... as well as a marvelous family package ... it wins our Top Rated award. ..." —*Family PC*, May 1996
- **Millennia** "In short, Micron covers all the bases with this Best Buy." —*PC World*, March 1996
- **Millennia TransPort** "... nearly a dead ringer for IBM's ThinkPad ... but performs better and saves you about \$2,500." —*PC Magazine*, April 1996

The Right System for You

Micron Electronics makes a suite of outstanding solutions designed for the way you work or play. From home systems to servers, desktop PCs to portable multimedia solutions, Micron Electronics always comes through with a system built to satisfy. For details and prices, turn the page.

**Micron Power****Warranty & Support**

- 5-year limited warranty on microprocessor and main memory
- 3-year limited parts-only system warranty
- 1-, 2- or 3-year optional on-site service agreements for Micron desktop systems
- 30 days of free Micron supplied software support for Micron desktop systems
- 30-day money-back policy
- 24-hour technical support

The foregoing is subject to and qualified by Micron's standard limited warranties and terms and conditions of sale. Terms and conditions of sale may vary for special configurations. Copies of the limited warranties may be obtained on our Web site or by calling Micron.

MICRONTM
ELECTRONICS, INC.

800-707-2329

<http://www.mei.micron.com>

With our legacy of memory and manufacturing expertise, Micron Electronics has just doubled memory in several systems (see configurations). We've added other powerful enhancements to give you a vast increase in system capacity.

MILLENNIA™ P200

- Intel 200MHz Pentium® processor
- 512KB pipeline burst cache, flash BIOS
- 12X EIDE CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers
- **PCI 64-bit 3D video, MPEG, 4MB EDO RAM**
- Tool-free minitower or desktop
- Microsoft® Mouse, 104-key keyboard
- Microsoft Windows® 95 & MS® Plus! CD
- 5-year/3-year Micron Power™ warranty

- **16MB EDO RAM** • 1.6GB EIDE hard drive
- 15" Micron 15FGx, 28dp (13.7" display)
- Microsoft Works 95 CD

\$1,999

Business lease \$68/month

- **32MB EDO RAM** • 2.5GB EIDE hard drive
- 15" Micron 15FGx, 28dp (13.7" display)
- Microsoft Office Pro 95 & Bookshelf® 95 CDs

\$2,299

Business lease \$78/month

- **64MB EDO RAM** • 3.1GB EIDE hard drive
- 17" Micron 17FGx, 28dp (15.8" display)
- Microsoft Office Pro 95 & Bookshelf 95 CDs

\$2,899

Business lease \$99/month

- With Intel 133MHz Pentium processor.....subtract \$300
- With Intel 166MHz Pentium processor.....subtract \$100

MILLENNIA™ P200 PLUS

- Intel 200MHz Pentium processor
- 512KB pipeline burst cache, flash BIOS
- PCI 32-bit Ultra SCSI Fast-20 controller
- 12X SCSI CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers
- **PCI 64-bit 3D video, MPEG, 4MB EDO RAM**
- Tool-free minitower or desktop
- Microsoft Mouse, 104-key keyboard
- Microsoft Windows 95 & MS Plus! CD
- 5-year/3-year Micron Power warranty

- **16MB EDO RAM** • 2GB Ultra SCSI hard drive
- 15" Micron 15FGx, 28dp (13.7" display)
- Microsoft Works 95 CD

\$2,699

Business lease \$92/month

- **32MB EDO RAM** • 4GB Ultra SCSI hard drive
- 15" Micron 15FGx, 28dp (13.7" display)
- Microsoft Office Pro 95 & Bookshelf 95 CDs

\$3,199

Business lease \$109/month

- **64MB EDO RAM** • 9GB Fast SCSI-2 hard drive
- 17" Micron 17FGx, 28dp (15.8" display)
- Microsoft Office Pro 95 & Bookshelf 95 CDs

\$4,799

Business lease \$163/month

- With Intel 166MHz Pentium processor.....subtract \$100

HOME MPC™ P133

- Intel 133MHz Pentium® processor
- 512KB pipeline burst cache, flash BIOS
- **16MB EDO RAM** • 1.6GB EIDE hard drive
- 12X EIDE CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers
- 28.8 fax/modem, speakerphone, voice mail
- Microsoft® Phone telephony software
- Internet ready: Free 1 month Spy Internet access; Microsoft Internet Explorer 3.0
- Prodigy®, America Online® & CompuServe trial memberships
- PCI 64-bit 3D video, MPEG, 2MB EDO RAM
- 15" Micron 15FGx, 28dp (13.7" display)
- Tool-free minitower or desktop
- Microsoft Mouse, 104-key keyboard
- Microsoft Windows® 95 & MS® Plus! CD
- Quicken® Financial Pak includes: Quicken Deluxe; Quicken Financial Planner™; Quicken Parents' Guide to Money™; and Quicken Family Lawyer™
- Family Pak includes: ABC by Dr. Seuss; Thinkin' Things® Collection 1; Earthworm Jim™; and Mechwarrior® 2
- Microsoft Home Pak includes: Works 4.0; Publisher Deluxe; Encarta®; CD Sampler; plus more
- 5-year/3-year Micron Power™ warranty

\$1,899

- With Intel 166MHz Pentium processor.....add \$200

HOME MPC™ P200

- Intel 200MHz Pentium processor
- 512KB pipeline burst cache, flash BIOS
- **32MB EDO RAM** • 2.5GB EIDE hard drive
- 12X EIDE CD-ROM drive, 3.5" floppy drive
- 16-bit 3D Wavetable stereo sound card
- Advent AV270 2x25 watt stereo speakers
- 28.8 fax/modem, speakerphone, voice mail
- Microsoft Phone telephony software
- Internet ready: Free 1 month Spy Internet access; Microsoft Internet Explorer 3.0
- Prodigy, America Online & CompuServe trial memberships
- PCI 64-bit 3D video, MPEG, 2MB EDO RAM
- 17" Micron 17FGx, 28dp (15.8" display)
- Tool-free minitower or desktop
- Microsoft Mouse, 104-key keyboard
- Microsoft Windows 95 & MS Plus! CD
- Microsoft Office Pro 95 & Bookshelf® 95 CDs
- Quicken Financial Pak includes: Quicken Deluxe; Quicken Financial Planner; Quicken Parents' Guide to Money; and Quicken Family Lawyer
- Family Pak includes: ABC by Dr. Seuss; Thinkin' Things Collection 1; Earthworm Jim; and Mechwarrior 2
- Microsoft Home Pak includes: Works 4.0; Publisher Deluxe; Encarta®; CD Sampler; plus more
- 5-year/3-year Micron Power™ warranty

\$2,899

- With Intel 166MHz Pentium processor.....subtract \$100

NEW

January 9, 1996
Millennia P200

Jan 28, 1996
Millennia P200

June 28, 1996
Millennia P200

August 1996
Millennia P200

May 30, 1995
Millennia P133

May 16, 1995
Home MPC P133

January 1996
Millennia P133

April 1996
Millennia TransPart

June 1996
Millennia P166

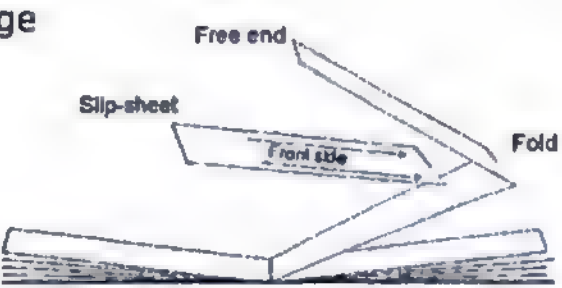
May 1996
Home MPC P133

December 1995
Millennia P133

Designed for
Microsoft®
Windows 95

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





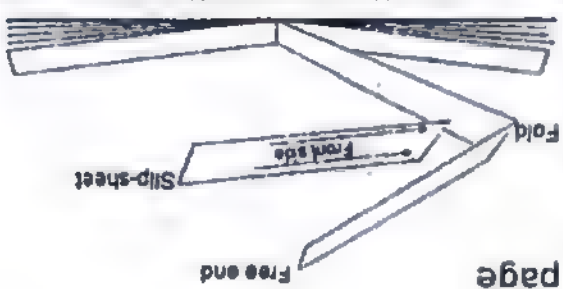
GbsSlipSheet-001

Inverted Foldout slip-sheet

Folded edge of the page

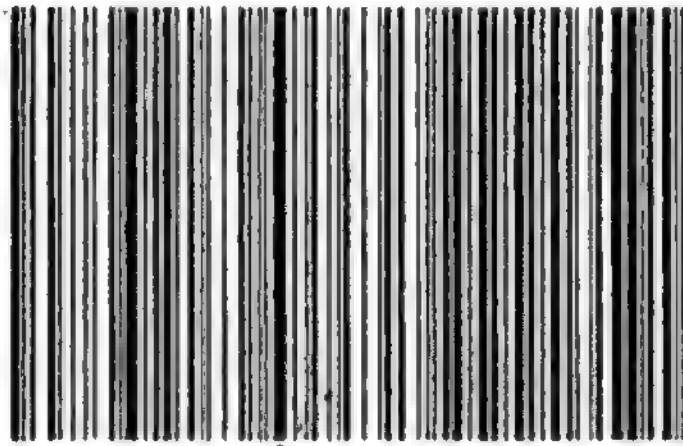
Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



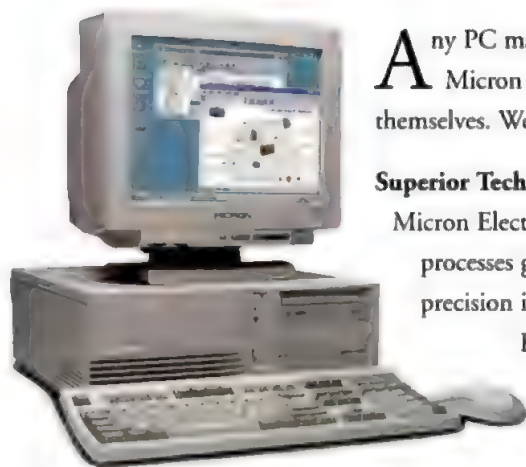
Gbs5lipBack-001B

Back

1. Follow instructions on the other side



SUPERIOR SOLUTIONS BY DESIGN



Any PC maker can claim to offer a solution that covers your needs. But at Micron Electronics, we prefer to let our history and our products speak for themselves. We think you'll agree it's an impressive story.

Superior Technology—A Micron Tradition

Micron Electronics builds PCs with a legacy of excellence. Our manufacturing processes grew out of nearly two decades in the semiconductor business, where precision is measured in millionths of an inch, and quality in parts per million.

From this solid background, we're forging unbeatable systems you can count on today and tomorrow.

Award-Winning Products

In the past two years, leading industry publications have applauded Micron Electronics PCs with more than 140 awards. This includes *PC Magazine* Best Products of 1995 and Editors' Choice awards in several categories. Add more than 40 *PC World* Best Buy awards and you've got an impressive technology hall of fame. In fact, just this summer, we have won three *PC Magazine* Editors' Choice® Awards for Millennia™ desktop and Millennia TransPort™ notebook computers.

Micron PowerSM Warranty—An Industry First

We support our reliability promise with the industry-leading Micron Power warranty. It backs the microprocessor and main memory for five years, an industry first. Add a three-year, parts-only system warranty and a 30-day money-back guarantee, and you can rest assured that you're in good hands.

MILLENNIA TRANSPORT™

- Mobile Intel Pentium® processor
- Intel 430MX PCI chipset
- 256KB L2 pipeline burst cache
- 8X modular CD-ROM drive
- PCI graphics accelerator, 1MB EDO RAM
- Pick-a-Point™ dual pointing devices integrate both pointing stick and touchpad
- Removable EIDE hard drive
- 3.5" modular floppy drive
- Intelligent modular lithium-ion battery
- 16-bit stereo sound
- Built-in stereo speakers and microphone
- 2 Type II or one Type III PCMCIA slots
- S-video and NTSC-video outputs
- Headphone, microphone and line-in jacks
- 2 infrared ports, one front, one back
- Parallel, serial, VGA and 2 PS/2 ports
- Dimensions: 11.7" x 9.4" x 2.0", Weight: 6.9 lbs.†
- Nylon carrying case
- Microsoft® Windows® 95 and MS® Plus! CD
- Microsoft Office Pro 95 and Bookshelf® 95 CDs
- Kensington™ security lock ready††
- 5-year/3-year Micron Power™ warranty

† 6.9 lbs. includes 3.5" floppy and one battery
†† Lock secures both Millennium Transport and MicronDock™



- 133MHz mobile Intel Pentium processor
- 16MB EDO RAM (48MB max.)
- 12.1" active matrix display, 800 x 600
- 1.3GB removable hard drive

\$4,399 Business lease \$150/month

- 133MHz mobile Intel Pentium processor
- 32MB EDO RAM (48MB max.)
- 12.1" active matrix color display, 800 x 600
- 1.3GB removable hard drive
- Motorola® Montano 28.8 fax/modem
- 2nd lithium-ion battery

\$5,199 Business lease \$163/month

- 150MHz mobile Intel Pentium processor
- 32MB EDO RAM (48MB max.)
- 12.1" active matrix color display, 800 x 600
- 2.1GB removable hard drive
- Motorola® Montano 28.8 fax/modem
- 2nd lithium-ion battery
- Samsonite® leather carrying case

\$5,550 Business lease \$174/month

OPTIONS

- With 150MHz mobile Intel Pentium processor add \$200
- With 2nd modular lithium-ion battery.....add \$199
- With primary 2.1GB hard drive upgrade.....add \$100
- With 2nd hard drive (1.3GB).....add \$599
- With 2nd hard drive (2.1GB).....add \$699
- With 16MB DIMM module upgrade.....add \$349
- With 32MB DIMM module upgrade.....add \$749

VETIX™ EL 1000

- Intel 200MHz Pentium® Pro processor
- Dual Pentium Pro ZIF sockets
- 256KB L2 cache, flash BIOS
- Memory upgradable to 512MB
- Slots: 1 ISA, 3 PCI; 1 shared PCI/ISA
- Adapter PCI 32-bit Ultra SCSI Fast-20 controller
- 8X SCSI-2 CD-ROM drive
- 3.5" floppy drive
- 64-bit 1MB ISA video
- 3Com® 3C595 PCI 10/100 ethernet NIC
- Full-size tower with 10 drive bays
- 15" Micron 15FGx, .28dp (13.7" display)
- Microsoft® Mouse, 104-key keyboard
- Novell® NetWare® 4.X (5 user license); Microsoft® Windows NT® Server 4.0 optional (call for pricing)
- NOS support (3 resolutions)
- 5-year/3-year Micron Power™ warranty

\$4,499 Business lease \$153/month

- 32MB EDO RAM
- 2GB Ultra SCSI hard drive

\$4,999 Business lease \$170/month

- With Sony 4/8GB SCSI DAT tape back-up drive.....add \$999

VETIX™ EL 2000

- Dual Intel 200MHz Pentium Pro processors
- 256KB L2 cache, flash BIOS
- Memory upgradable to 512MB
- Slots: 1 ISA, 3 PCI; 1 shared PCI/ISA
- Adapter PCI 32-bit Ultra SCSI Fast-20 controller
- 8X SCSI-2 CD-ROM drive
- 3.5" floppy drive
- 64-bit 1MB ISA video
- 3Com 3C595 PCI 10/100 ethernet NIC
- Full-size tower with 10 drive bays
- 15" Micron 15FGx, .28dp (13.7" display)
- Microsoft Mouse, 104-key keyboard
- Novell® NetWare 4.X (5 user license); Microsoft Windows NT Server 4.0 optional (call for pricing)
- NOS support (3 resolutions)
- 5-year/3-year Micron Power warranty

\$5,299 Business lease \$166/month

- 32MB EDO RAM
- 2GB Ultra SCSI hard drive

\$6,999 Business lease \$218/month

- With Sony 4/8GB SCSI DAT tape back-up drive.....add \$999

MILLENNIA™ Pro2 200

- Intel 200MHz Pentium® Pro processor
- Supports dual Intel 200MHz Pentium Pro processors
- 256KB internal cache, flash BIOS
- 12X EIDE CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers
- PCI 64-bit 3D video, MPEG, 4MB EDO RAM
- Tool-free minitower or desktop
- Microsoft® Mouse, 104-key keyboard
- Microsoft Windows® 95 & MS® Plus! CD
- 5-year/3-year Micron Power™ warranty

- 16MB EDO RAM • 2.5GB EIDE hard drive
- 15" Micron 15FGx, .28dp (13.7" display)
- Microsoft Works 95 CD

\$2,299 Business lease \$78/month

- 32MB EDO RAM • 3.1GB EIDE hard drive
- 17" Micron 17FGx, .26dp (15.8" display)
- Microsoft Office Pro 95 & Bookshelf® 95 CDs

\$2,799 Business lease \$97/month

- With 2nd Intel 200MHz Pentium Pro processor.....add \$699
- With MS Windows NT Workstation 4.0.....add \$99

*Second processor requires Microsoft Windows NT

MILLENNIA™ Pro2 400 Plus

- Dual Intel 200MHz Pentium Pro processors
- 256KB internal cache, flash BIOS
- PCI 32-bit Ultra SCSI Fast-20 controller
- 12X SCSI CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers
- PCI 64-bit 3D video, MPEG, 4MB EDO RAM
- Tool-free mini tower or desktop
- Microsoft Mouse, 104-key keyboard
- Microsoft Windows NT Workstation 4.0 CD
- Microsoft Office Pro 95 & Bookshelf 95 CDs
- 5-year/3-year Micron Power warranty

- 32MB EDO RAM • 2GB Ultra SCSI hard drive
- 15" Micron 15FGx, .28dp (13.7" display)

\$3,899 Business lease \$133/month

- 64MB EDO RAM • 4GB Ultra SCSI hard drive
- 17" Micron 17FGx, .26dp (15.8" display)

\$4,749 Business lease \$161/month

- 128MB EDO RAM • 9GB Fast SCSI-2 hard drive
- 21" Micron 21FGx, .26dp (20.0" display)

\$6,999 Business lease \$220/month

CLIENTPRO™ P120

- Intel 120MHz Pentium® processor
- 256KB pipeline burst cache, flash BIOS
- 16MB EDO RAM
- 3Com® 3C509 Combo network adapter
- 3.5" floppy drive
- PCI 64-bit graphics accelerator, 2MB EDO RAM
- Tool-free minitower or desktop
- Microsoft® Mouse, 104-key keyboard
- MS-DOS® 6.22/Windows® for Workgroups 3.11
- Microsoft Works preinstalled
- 5-year/3-year Micron Power™ warranty

- 1.2GB EIDE hard drive
- 14" Micron 14FGx, .28dp (12.9" display)

\$1,499 Business lease \$51/month

- 2.1GB EIDE hard drive
- 15" Micron 15FGx, .28dp (13.7" display)

\$1,699 Business lease \$58/month

- With Intel 133MHz Pentium processor.....add \$50

CLIENTPRO™ 2 180

- Intel 180MHz Pentium Pro processor
- 256KB internal burst cache, flash BIOS, DMI support
- 3Com 3C509 Combo network adapter
- PCI 64-bit graphics accelerator, 2MB EDO RAM
- 3.5" floppy drive
- Tool-free minitower or desktop
- Microsoft Mouse, 104-key keyboard
- Microsoft Windows NT® Workstation
- 5-year/3-year Micron Power warranty

- 16MB EDO RAM • 1.2GB EIDE hard drive
- 15" Micron 15FGx, .28dp (13.7" display)
- Microsoft Works preinstalled

\$1,999 Business lease \$68/month

- 32MB EDO RAM • 2.1GB EIDE hard drive
- 15" Micron 15FGx, .28dp (13.7" display)
- Microsoft Office Pro 95

\$2,299 Business lease \$78/month

- 32MB EDO RAM • 3.1GB EIDE hard drive
- 17" Micron 17FGx, .26dp (15.8" display)
- Microsoft Office Pro 95

\$2,599 Business lease \$88/month



pentium

International Sales
208-893-8970



International Fax
208-893-7393



Tollfree from Puerto Rico
800-708-1756



Tollfree from Canada
800-708-1758



Tollfree from Mexico
95-800-708-1755

• Technical Support Available 24 Hours A Day-7 Days A Week
• Technical Support E-mail: techsupport.mex@micon.com

• 900 E. Karcher Road, Nampa, ID 83687
• Mon-Fri 6am-10pm Sat 7am-5pm (MT)
• International Sales Hours: Mon-Fri 6am-7pm (MT)
• 208-893-3434 • Fax 208-893-3424
• Purchase Order Fax 208-893-8992
• GSA Contract #GS35F4317D

MICRON™
ELECTRONICS, INC.

800-707-2329
<http://www.mei.micon.com>

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Make a Great PC Even Better!

Custom configure your new Micron Electronics system with these popular options.

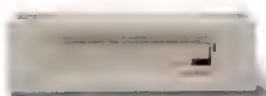
MULTIMEDIA OPTIONS

- 16-bit 3D Waveable stereo sound.....\$59*
- 16-bit 3D Waveable stereo soundcard w/2MB RAM.....\$99*
- Advent AV270 Powered Partners stereo speakers.....\$99
- Advent AV370 Powered Partners stereo speakers w/subwoofer.....\$199
- Microsoft® SideWinder™ 3D Pro joystick.....\$59



STORAGE/MEDIA OPTIONS

- Adaptec® 2940U Ultra SCSI Fast-20 controller.....\$100
(upgrade from system with standard Ultra SCSI Fast-20 controller)
- Plextec 12Plex 12X 1.0MB/S SCSI internal CD-ROM drive.....\$200**
(upgrade from systems with standard 12X EIDE CD-ROM drive)
- Iomega Jazz SCSI drive with 1.0GB removable cartridge.....\$399**
- Iomega Zip IDE drive with 100MB removable cartridge.....\$99
- Iomega 6-pak of 100MB Zip cartridges.....\$99
- Iomega Ditto 800 (400/800MB) Travan Tape back up w/tape.....\$149
- Iomega Ditto 3200 (1.6/3.2GB) Travan Tape back up w/tape.....\$199
- Sony 4/8GB DDS-2 DAT SCSI Tape back up w/tape.....\$999**



COMMUNICATION OPTIONS

- 33.6kb V.34 internal data/fax modem.....\$139***
- 28.8kb V.34 internal telephony data/fax modem
w/full duplex speakerphone and voice mail.....\$159****†

NETWORKING OPTIONS

- 3Com® 3C509 Ethernet ISA NIC (BNC, AUI & RJ-45).....\$99
- 3Com 3C595 Fast Ethernet PCI 10/100 NIC (RJ-45 only).....\$159
- SMC ISA TokenCard network card.....\$199

QUICKEN® FINANCIAL PAK

- Quicken Financial Pak, including: Quicken Deluxe 5.0; Quicken Financial Planner™; Quicken Parents' Guide to Money™; Quicken Family Lawyer™.....\$69
(on desktops with Windows 95)

- * Upgrade from systems with standard 16-bit stereo sound card
- ** Requires SCSI Host Adapter
- *** V.34 modem includes trial memberships to CompuServe®, Prodigy® and America Online®
- † Requires sound card
- †† Upgrade from systems with standard Micron 17" 17FGx color monitor
- ††† Upgrade from systems with standard 64-bit 2MB video card

Options and accessories available with system purchase only.

EDVENTURE PAK

- EdVenture Pak, including: Sheila Ray, the Brave; Pott-Pott® Saves the Zoo™; Roader Rabbit's Reading Development Library™ 1; Freddy Fish™ and the Case of the Missing Kelp Seeds™; and the Thinkin' Things™ Collection 2.....\$69
(on desktops with Windows 95)

DISPLAY/VIDEO OPTIONS

- 17" Hitachi SuperScan 1711 (15.9" display) .26dp color monitor.....\$150 ††
- 21" Hitachi SuperScan 2111 (20" display) .26dp color monitor.....\$650 ††
- #9 Imagine 128 series II video card w/4MB VRAM.....\$500 †††
- #9 Imagine 128 series I video card w/8MB VRAM.....\$750 †††

MILLENNIA TRANSPORT™ OPTIONS

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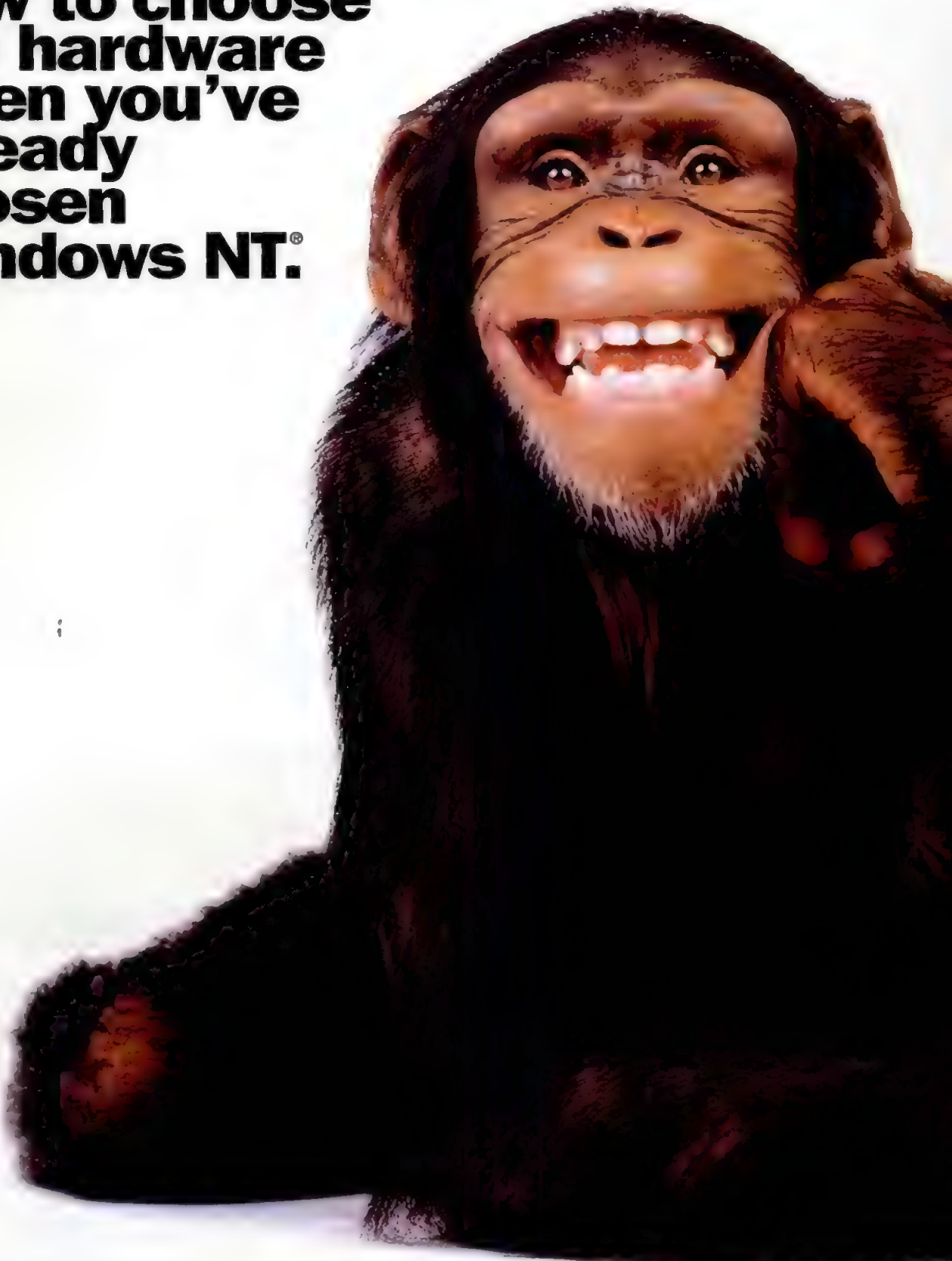
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How to choose
the hardware
when you've
already
chosen
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First Looks

mind when shopping. The design includes seven status indicators, but there is neither an alphanumeric display nor a speed indicator. The inclusion of a volume control—which none of the others modems has—means you can adjust the sound level of the screeches, thumps, and static that are part and parcel of making data connections.

The unit doesn't store its firmware in upgradable flash memory, but like the Zoom V.34X Plus, it does support caller ID and distinctive ring. The Sportster works with all major error-control and data-compression command sets, and it offers Group 3 fax compatibility with support for Class 1 and 2 fax machines.

The software bundled with the Sportster separates it from the pack. The CD-ROM contains start-up kits for America Online, CompuServe, Global Network Navigator, NetCom, and Spry Mosaic. There's also the requisite fax package, Quicklink II. In addition to these, U.S. Robotics provides four extra programs: PC411 for Windows, which offers 10 free online searches of U.S. and Canadian telephone listings (First Looks, March 26, 1996); SurfWatch, which allows you to control the Web sites your children can access; and trial versions of Quicken and an antivirus package from Iris Software.

The CD also incorporates answers to a list of frequently

asked support questions, an online user's guide, and all of U.S. Robotics' technical support numbers. There's even a guide book for the Internet that includes chapters on Internet browsers, search tools, and home pages. It's all a bit rudimentary for the seasoned Web user, but it's just what newcomers to the Net will appreciate.

Performance is another strong point for the Sportster. On both the Throughput vs. File Type and Telephone-Network Simulation tests, it posted the highest numbers overall, beating the next best competitor—the Cardinal MVPV34XF—by a wide margin. This shows that the modem is just as adept at transferring various file types as it is at functioning under a number of different line conditions. The Modem Compatibility results were another story. At 21 percent, the Sportster had the lowest tested compatibility of the five modems we looked at. This may be deceptive, however, because the modem made quick and reliable connections to several ISPs and online providers.

U.S. Robotics offers the same five-year warranty as most of the other vendors in this review, but it has the only toll-free number for technical support. The number is accessible between 9:00 and 5:00 (eastern time).



Zoom V.34X Plus

Street price: \$140

Requires: PC serial port

Zoom Telephonics Inc., Boston

800-631-3116; fax, 617-423-3928

www.zoomtel.com

Circle 416 on reader service card

CHEAP TO KEEP: At \$139, the Zoom V.34X Plus is an exceptional value. Turn the unit over and you'll find explanations of the indicator lights (inset).



With its unequalled performance, superior software selection, and toll-free technical support, the U.S. Robotics Sportster 33.6

Faxmodem is a one-stop communications center.

Zoom Telephonics Inc.

Zoom V.34X Plus

At a street price of just \$140, the Zoom V.34X Plus may not be the cheapest modem around, but it may very well be today's best bargain. With its steady performance and decent software bundle, the V.34X Plus gives you communications on the cheap.

Although the Zoom package didn't include a serial cable, inside the box is an informative setup guide and a handy quick-reference card for basic guidance during setup and initial operation. The modem's design includes an angled front panel that incorporates 14 LED indicator lights. There is no alphanumeric display, but the modem has one light that shows connection speed. A nice touch is the addition on the unit's underside of each indicator's abbreviation with a brief explanation.

The V.34XF is based on a Rockwell chip set and a Rockwell signal converter. It is one of only two modems in this group (the Sportster 33.6 Faxmodem is the other)

that supports both caller ID and distinctive ring. It doesn't, however, store its firmware in flash memory. The V.34 Plus is a Group 3 fax modem that supports both Class 1 and Class 2 fax machines.

The software bundled with the V.34X Plus includes start up kits from America Online and CompuServe, and Internet access via Global Network Navigator; the modem comes with WinFax Lite.

The V.34X Plus proved itself to be an even-handed performer on our tests. On the Modem Compatibility tests, however, the V.34X Plus showed 100 percent compatibility with our test modems. On the Throughput vs. File Type test, the V.34X Plus's score was slightly below average, which may indicate potential problems in transmitting a variety of file types.

The V.34X Plus's seven-year warranty is second only to Cardinal's lifetime protection in this roundup; technical support is available through a toll call Monday through Friday from 8:30 to 11:00 and on Saturdays from 9:00 to 5:00 (eastern time). Zoom also offers tech support through America Online, its Web site, and an electronic bulletin board.

Although there are modems that have better performance and include more software, you'll be hard-pressed to find one that provides more for less. If price is your top priority, grab the Zoom V.34X Plus.

Sportster 33.6 Faxmodem

Street price: \$180

Requires PC serial port

U.S. Robotics Inc., Shakopee, IL

800-342-5877, 947-962-5181

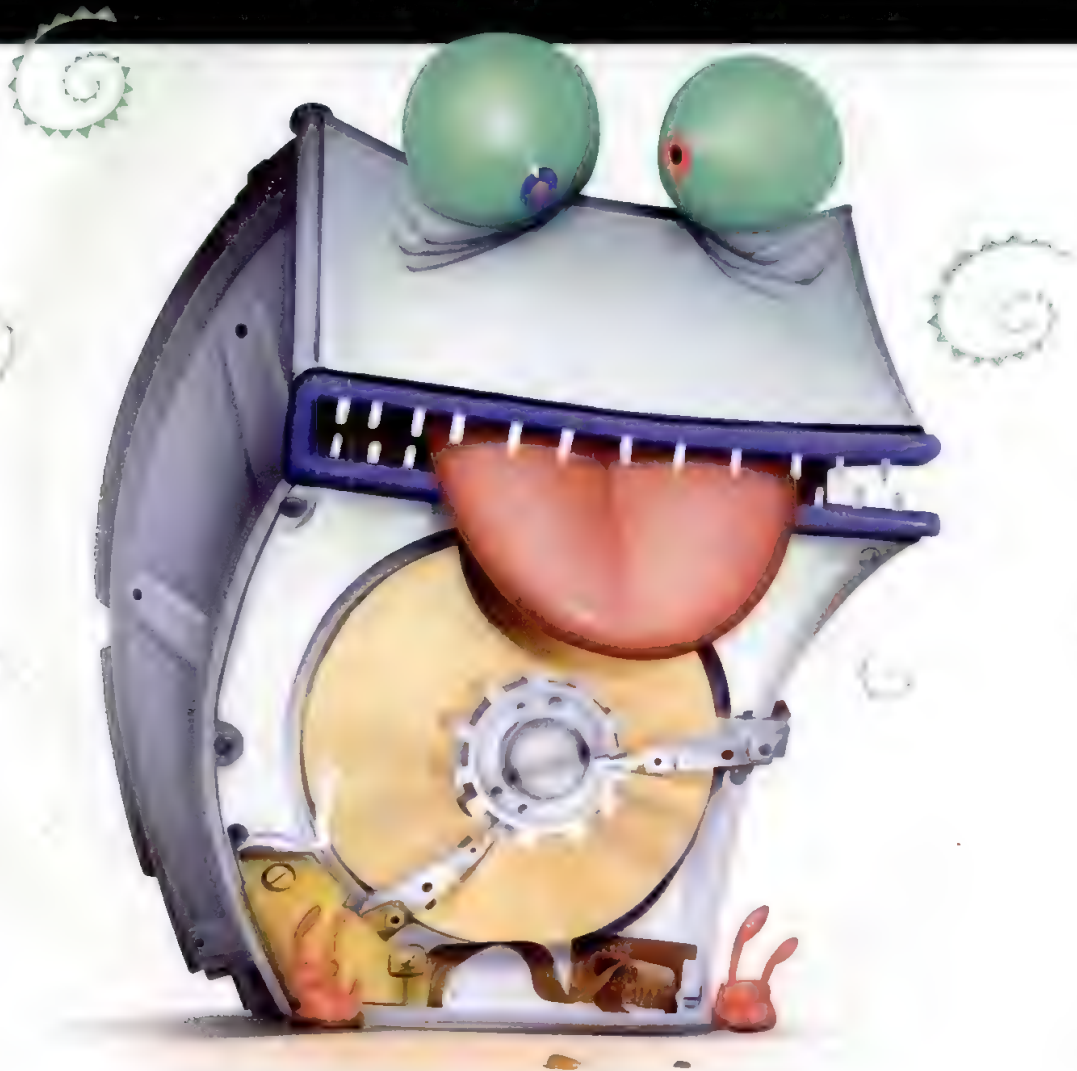
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BEST ALL-AROUND: The U.S. Robotics 33.6 Sportster Faxmodem offered the best mix of performance, software, and tech support.



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First Looks

PCs

The Portable Desktop

The innovative, all-in-one Compaq Presario 3020 revives the concept of the monputer. —By John Morris

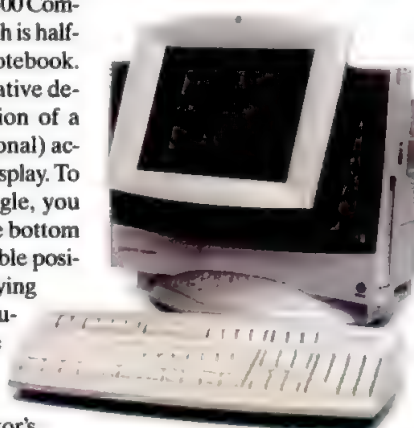
Finally, PC vendors are moving away from tired putty-gray desktop and mini-tower cases, experimenting with designs that borrow from home electronics. Most of this innovation is on the home front, and the latest example is the \$3,500 Compaq Presario 3020, which is half-desktop PC and half-notebook.

The key to its innovative design is the incorporation of a hinged 12.1-inch (diagonal) active-matrix flat-panel display. To adjust the display's angle, you simply grasp it from the bottom and tilt it to a comfortable position. Capable of displaying 65,000 colors at a resolution of 800 by 600, the LCD screen provides a viewing space equivalent to a 15-inch monitor's.

GRAB 'N GO

Look to the right side and you'll see a cordless mouse, which connects with the PC via a radio-frequency link and rests securely in a holder. The integrated mouse makes the Presario 3020 relatively easy to move around. Unplug the power cord, grab the 30-pound unit by its handle, and you can tote it around the house with ease. Keep it in the study to work

on the family's finances, set it up in the den to play games, or move it into the kitchen to download recipes from the Internet. And because case and monitor are only about 10 inches deep (compared to the typical 15-inch mon-



boom box. A pair of JBL Pro Audio speakers span the front of the case, cradling the flat-panel display, and the unit includes a 16-bit wavetable sound card. The sound was so good that we found ourselves using the system as a totable CD player.

A cluster of buttons on the unit's base provide quick access to audio controls for the NEC four-disk 6X CD changer, which is vertically mounted on the right side of the case. A helpful utility allows you to access all four CD-ROMs from a single drive letter. The other buttons operate the Presario's brightness control, full-

PRESTO PRESARIO: With its integrated 12.1-inch LCD screen and built-in handle, the Compaq Presario 3020 is ready to be moved. The wireless mouse comes with its own room (inset).



itor's 16-inch depth), the system can fit on most household surfaces, from a coffee table to a kitchen countertop.

The Presario 3020's design favors ease of use and of setup above all else: All of the ports are color coded and reside on the left side of the case, within easy reach. It took less than 2 minutes to get the system out of the box, plugged in, and running.

The Presario 3020 is also part

duplex speakerphone (a 33.6-Kbps DSVD modem is standard), digital answering system, and Compaq's SmartQ software, which lets you configure up to eight password-protected workspaces for family members.

Don't be fooled by the Presario 3020's unorthodox exterior; the unit is equal parts function and form. The system we tested came with a 166-MHz Pentium CPU, 24MB of EDO RAM,

256K of external cache, a 2GB EIDE hard disk, and a Compaq-branded PCI-based graphics board that uses S3's Aurora 64V+ chip.

CRAMPED QUARTERS

As with earlier Presario monputers, the price you pay for the Presario 3020's graceful lines and easy portability is its limited expandability. The floppy disk drive is molded to the case, and there are no open external drive bays. To install an internal device, you'd have to remove the CD changer, which Compaq doesn't recommend. Inside the stylishly curved case are two PCI and two ISA slots, along with a pair of Universal Serial Bus connectors.

On our benchmark tests, the Presario 3020 was a solid performer, although exact comparisons were difficult because few systems come equipped with 24MB of RAM. Compared with the 51 Pentium/200 class PCs with 16MB of RAM, the Presario 3020 held its own on Business Winstone 97 and Business Graphics WinMark 97. The Presario 3020 could not compete with its more powerful brethren on the 32-bit CPU benchmark tests or the Disk and CD-ROM WinMark tests, however.

This technology doesn't come cheap. At \$3,500, the Presario 3020 is comparable to the Editors' Choice-winning Toshiba Infinia 7200 with a Pentium/200 CPU, 32MB of RAM, a TV tuner, and a 17-inch monitor ("Home Is Where the PC Is," October 22, 1996).

The Presario 3020 successfully merges the convenience and portability of a monputer with the power and functionality of a high-end SOHO PC.

Compaq Presario 3020. Street price: \$3,500. With Pentium/166 CPU, 24MB RAM, 256K external cache, 6X CD-ROM drive, 2GB hard disk. Compaq Computer Corp., Houston; 800-652-6672, 713-370-0670; www.compaq.com. Circle 411 on reader service card.

BENCHMARK TESTS

Compaq Presario 3020



With an extra boost from its 24MB of RAM, the Compaq Presario 3020's test results were in the same league as the average scores of Pentium/200-class desktop PCs with 16MB of RAM.

The Presario 3020, with its Pentium/166 CPU, came closest to matching the average

Pentium/200-class PC scores on the Business Graphics WinMark 97 and Business Winstone 97 tests. It did not perform as well on the 32-bit CPU tests, or on the disk and CD-ROM tests.

To test the performance of the Presario 3020, we used ZD Winstone 97 and ZD WinBench 97. The Presario 3020 ran Microsoft Windows 95.

Higher scores represent better performance.	ZD Business Winstone 97	ZD Business Graphics WinMark 97	ZD Business Disk WinMark 97 ¹	ZD CPUmark ₉₉	ZD CPUmark ₃₂	ZD CD-ROM WinMark 97 ¹
Compaq Presario 3020	31	39.8	453	305	292	569
Average P/200 or Cyrix 6x86-200+ ²	34	47.1	640	356	357	743

(1) Thousands of bytes per second (2) 51 PCs reviewed in this issue.

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First Looks

NOTEBOOKS

The WideBody Notebook

Sharp's WideNote combines a more expansive view of your data and a desktop-size keyboard.—By Alfred Poor

In a market filled with look-alike notebooks, Sharp has rewritten the rules with its \$3,500 W-100T WideNote, which uses an extrawide screen to show nearly 30 percent more of your data and incorporate a desktop-style keyboard.

The center of attention is the system's active-matrix display, which is only marginally bigger than a standard 10.2-inch screen. Measuring 11.2 inches diagonally (9.5 by 5.6 inches), the WideNote's panel is a little narrower, but more than an inch wider, than the standard 8.3-by-6.2-inch dimensions of a typical 10.2-inch diagonal screen.

With a resolution of 1,024 by 600, the WideNote's unique screen looks like a standard 800-by-600 screen with an extra 224-by-600 strip added to one side. This produces room for 28 percent more data.

The WideNote's 16:9 wide aspect ratio is the same used by the new high-definition television (HDTV) systems. The practical result is that you can put two application windows side by side, which makes it easy to refer to one while working on the other or to cut and paste between them.

Internally, the WideNote uses

an S3 86CM65 graphics accelerator and is configured with a special Microsoft Windows display mode. You can also choose a 1,024-by-768 resolution virtual desktop.

Although the wide-body design allows for a full-size keyboard, it flexes and sags slightly.



includes a GlidePoint touch pad in front of the spacebar.

Tipping the scales at a svelte 4.6 pounds, the WideNote is no heavy load. To arrive at this admirably thin and light system, Sharp built the floppy disk drive as an external unit that connects via either the parallel port and the external mouse/keyboard port. The floppy disk drive and

all scores were similar to those of a group of five Pentium/133 notebooks. At under 2 hours, the life of the system's lithium ion battery was disappointing.

At \$3,500, the Pentium/133 W-100T is competitively priced for a system that includes 16MB of EDO memory, 256K of external cache, a 1.1GB hard disk, and a 28.8-Kbps fax/data mo-



WIDE LOAD: The Sharp WideNote's wider display provides room for 28 percent more data (see dotted line) and makes it practical to put two applications side by side on your notebook screen.

ly. To accommodate the wide screen, the WideNote is long and lean, with a footprint of 11.6 by 7.7 inches (it is 1.6 inches thick). This is slightly smaller but 0.3 inch thicker than the Editors' Choice-winning IBM ThinkPad 560 (see "Portable Property," August 1996). As a result of the extrabroad case, the system's keyboard comes with comfortable oversize Enter, Backspace, Tab, and Caps Lock keys. The unit also

power adapter each weigh in at 14 ounces.

The system has built-in Sound Blaster-compatible audio, along with a microphone and speakers. The internal speakers are functional but can sound tinny; there are jacks for headphones or external speakers, but these are located inconveniently on the back of the case.

In terms of performance, the WideNote was unspectacular but not disappointing. Its over-

dem. The system has a high-speed infrared data window that complies with the IrDA standard as well as a pair of Type II PC Card slots.

About \$200 less expensive than the ThinkPad 560, the WideNote has a smaller—but wider—display with room for more data. For those limited by a tight budget, there's a dual-scan model, the W-100D, which has a street price of \$3,000.

The WideNote may not offer the highest possible display resolution, but its screen is the widest you can get today. Sharp hopes the extra space will appeal to road warriors who want to see more data at a glance.

WideNote W-100T. Street price: With Pentium/133 CPU, 256K external cache, 16MB RAM, 1.1GB hard disk drive, 11.2-inch active-matrix display, \$3,500. Sharp Electronics Corp., Mahwah, NJ; 800-237-4277; www.sharp-usa.com. Circle 410 on reader service card.

BENCHMARK TESTS

Sharp WideNote W-100T

Compared with a group of five Pentium/133 notebooks, the Sharp WideNote W-100T held its own. The WideNote's excellent Business Graphics WinMark 97 result and slightly better processor scores were balanced by its short

battery life and subpar Winstone performance.

To gauge the performance of this notebook we used ZD Winstone 97, Version 1.0; ZD WinBench 97, Version 1.0; and ZD BatteryMark. The system had 16MB of RAM and ran Windows 95.

	ZD Business		ZD Business		ZD	
	Winstone 97	Graphics WinMark 97	Disk WinMark 97 ¹	CPUmark ₉₉	CPUmark ₃₂	BatteryMark ²
Sharp WideNote W-100T	19	37.0	336	249	247	1:52
Average of 5 Pentium/133 notebooks	23	33.4	360	237	231	2:14

(1) Thousands of bytes per second. (2) Hours/minutes.

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First Looks

ILLUSTRATION

Express Your Creativity

Using advanced vector technology, *Fractal Design Expression* lets creativity rule. —By Daniel Grotta and Sally Wiener Grotta

Fractal Design Expression (\$499) is like a breath of fresh air for vector-based drawing programs. Placing the emphasis on creative freedom, Expression avoids focusing on such static, primitive objects as circles, squares, and polygons. Instead it uses hundreds of natural media and brushes to let you build stunning illustrations.

Expression's fluid style makes the package appear at first to be like a pixel-based bitmap program (such as Fractal Painter). But the big difference is that everything in Expression is object-oriented. That means no more pixels hogging computer resources, slowing down brush strokes, or creating huge image files. The result is that Expression pushes experienced digital artists to new heights and opens vistas of creativity to novices.

Expression's CD-ROM installation is quick and automatic. Initially, the program's interface looks like standard Windows 95 fare. But when you open the palette called Stroke Warehouse, Expression's personality becomes apparent. Inside are natural media, graphical elements, and multiview brush strokes. The program includes a library of 350 predefined strokes, which you edit, customize, or add to.

The program's brushes are defined using Expression's Skeletal Stroke technology, which incorporates three elements: a line segment, a shape that follows the line, and a fill (a color, a multicolor gradient, or a pattern). The shape can be literally anything—a drawing,

a single character, a block of text, or a logo.

Because these techniques and features are vector-based, their

minimal page-layout features and text-handling tools. The program supports professional-level color-support systems, including HSL, RGB, and CMYK color models, as well as a multicolor gradient tool and the ability to import or create custom color palettes.

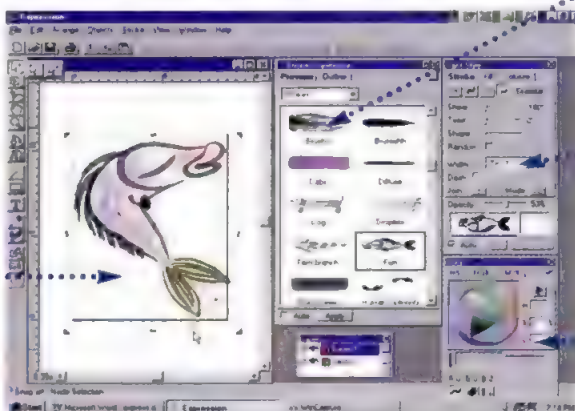
Expression can import

exports illustrations to a large number of file formats, such as .EPS, .WMF, Photoshop 2.5, TIFF, Targa, among others. Be warned though: We found that if

you export an Expression file to another illustration program, some of the stroke transparency levels may not be supported by the other software.

Expression puts it all together so well that you forget about the technology behind it and concentrate on the interaction among color, textures, and shapes. **Fractal Design Expression.** List price: \$499. Requires: 12MB RAM, 20MB hard disk space, Microsoft Windows 3.1 or later, Windows 95, or Win-

Though the illustration looks like a bitmapped drawing, all items are moveable vector-based objects.



FISHY BUSINESS: Expression is like a design factory for illustrations in the making.

actions are nearly instantaneous. This, along with the program's support for pressure-sensitive digitizing tablets, gives rise to remarkable feedback and control.

We started an illustration of a jungle of trees by defining a single tree as a new brush stroke. Then we sketched numerous lines, each of which became a tree. We customized the individual trees by editing the nodes (control points) of the initial curve, bending the trees this way and that, making some fatter, others thinner. A few more curves and the line of trees became a grove, then a forest, and finally a dense jungle, with trees of different colors and transparency levels.

Expression's Multi-View Strokes feature takes this concept a step further. If you have two (or more) versions of a single stroke, Expression can create a morph between them, with each intermediate step defined as another unique brush stroke.

Expression's reverse path tool is an innovative and useful tool. Click on a curve to flip it; it's that easy. Yet there are only

images from Adobe Illustrator and CorelDraw, as well as .CGM, vector .PCX, and .WMF formats. On the output side, Expression

dumps NT. Fractal Design Corp., Scotts Valley, CA; 800-846-0111; www.fractal.com. Circle 406 on reader service card.

PC CARDS

The Notebook Surfboard

Angia Communications' I-Bahn gives your notebook access to a digital connection while you're on the road. —By Alfred Poor

Anatural follow-on to the profusion of ISDN adapters for desktop PCs, Angia Communications' \$575 I-Bahn ISDN PC Card adapter gives portable PCs access to digital communications as well as traditional analog phone lines.

The I-Bahn Type II PC Card comes in two models, each of which includes a jack for a headset, so you can use the device for analog phone calls over ISDN lines. We tested the unit with a U adapter, which includes an NT-1 interface. If your ISDN line is already equipped with an NT-1 adapter, get the S/T model and save \$60. The only other differ-

ence between the two models is that the U model does not support MP (Multilink PPP), which lets you combine both ISDN channels for 128-Kbps throughput.

The only installation hitch was that the I-Bahn's driver was set to "Wait for Dial Tone before Dialing;" ISDN lines don't use a dial tone. This was easily fixed, however, and we were soon nosing around the Web at 64 Kbps using Internet Explorer. Oddly, the I-Bahn doesn't include a Web browser.

It would be wishful thinking to expect to find an ISDN connection in your next hotel room, so the I-Bahn includes a

A wide variety of media is stored in the Stroke Warehouse palette.

You can customize strokes and transparency levels.

Use your choice of professional color-management systems or import a custom color palette.

V.34 data/fax modem capable of 28.8-Kbps data throughput. Angia also includes a copy of QuickLink II from SmithMicro Software. To switch between digital and analog, you just have to remove the black plastic ISDN SafeJack connector that plugs into the edge of the card and plug in the analog connector. You also need to send a reset command to the device before proceeding.



PLUG AND RUN:
The I-Bahn PC Card modem brings digital connections to road warriors.

In addition to the needed driver, Angia provides a Configuration Manager utility that you use to program your ISDN settings. You can store multiple profiles, making it easy

to use the I-Bahn at different locations. The Configuration Manager also has a simple Terminal feature, which lets you send commands directly to the device. We found this handy for troubleshooting.

If you have a serious need for speed but don't want to be tied to your desk, the I-Bahn gives you full-tilt online access at a reasonable cost.

I-Bahn. List price: \$575. Requires: Type II PC Card slot. Angia Communications Inc., Provo, UT; 800-877-9159, 801-373-9847; www.angia.com. Circle 405 on reader service card.

MULTIMEDIA

Instant Multimedia: Just Add Words

Whether it's for the Web, a presentation, or internal distribution, Astound makes multimedia a lot easier to handle.—By David Haskin

Astound has long been a secret weapon for non-technical users wanting to create eye-popping multimedia presentations. Astound not only makes creating multimedia presentations easier than ever, but it can create sophisticated Web pages with a minimum of fuss.

As with Microsoft PowerPoint's AutoContent, Astound's HeadStart templates create basic presentations for a broad range of topics, from product rollouts to training. Pick the most appropriate heading, replace the dummy text, graphics, and images with your own and you have a complete presentation.

Astound comes with 2,000 pieces of clip media and 100 animated templates in which the background graphical elements roll, swoop, and otherwise materialize during on-screen presentations. While its basic charting abilities are commonplace compared to PowerPoint's, the effects you apply to finished charts are remarkable. We were able to make pie slices roll onto the screen and a set of bars in a bar chart grow one at a time, with sound effects for each.

Rather than relying on clumsy external players, Astound is unique in having built-in sound,

video, and animation players for adding and controlling multimedia. Astound's time lines precisely set when each element on a slide appears and disappears. The redesigned Media Manager is an Explorer-like utility for sorting out multimedia elements.

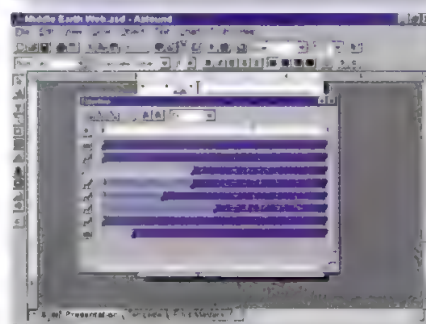
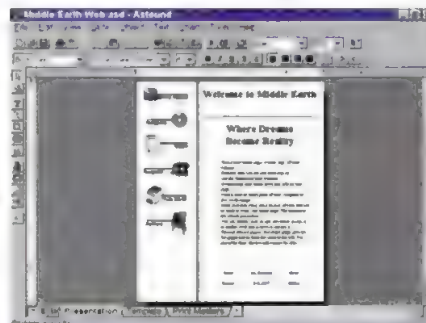
Astound is a surprisingly strong In-

HOME PAGE TO GO: You can use Astound's Web templates (top) to develop entire Web sites as easily as you create presentations. Astound's time lines (bottom) provide precise controls over the appearance and motion of on-screen elements ranging from text to video.

ternet authoring tool that goes beyond adding Web links to slides. With Astound, you can include ActiveX controls, Java applets, and VisualBasic scripts.

Saving your presentation in HTML format maintains the graphical and layout elements from the slides. That means you

can create Web pages that look and act like presentations or use the included Web-specific templates to create standard-looking Web pages. If you save your slides in Astound's proprietary format,



site visitors who use Astound's Web Player plug-in can view the presentation with streaming playback of multimedia.

While Astound's skills at tweaking basic presentations

are solid and easy to learn, the tools are unspectacular. For example, we were able to add effects—shadows, for instance—to text by clicking on toolbar buttons and quickly apply paragraph styles similar to those in word processors. But Astound doesn't support pair kerning for typographical precision, and sometimes this shows in awkwardly spaced characters.

Astound continues its lead in path animation. Just select the path and speed for the appearance and exit of each element—such as text or images—in a slide. If you prefer, you can draw the path freehand. There are special effects, such as the bullet point that rolls in from the upper left corner, bounces off the right edge of the slide, and settles into place, that at first appear cute but can become tedious.

The program supports 25 chart types—far fewer than PowerPoint—but the strong chart-formatting skills make up for this deficiency. It is simple, for example, to set the thickness of bars and pie slices as well as the formatting for such basic items as legends and axis labels.

To improve navigation, Astound's interface sports three new tabs: One shows the slide, another an editable version of the template underlying the slide, and the third master pages for printing your presentation. In addition, the QuickSet dialog box speeds up common tasks by providing tabs for such chores as setting fills, patterns, and borders, creating hyperlinks, and adding transitions between slides.

Even if your primary interest is creating old-fashioned text-and-bullet presentations, Astound is a good choice. But it's a compelling choice if you want to create sophisticated Web pages or grab your audience's attention with multimedia.

Astound. List price: \$249. Requires: 8MB RAM; 20MB hard disk space, Microsoft Windows 3.1, Windows 95, or Windows NT. Astound Inc., Palo Alto, CA; 888-427-8686, 415-845-6200; www.astoundinc.com. Circle 408 on reader service card.

First Looks

MAPPING SOFTWARE

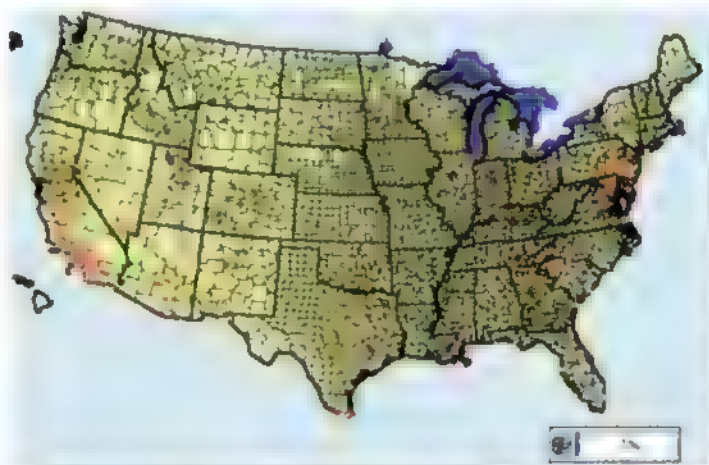
Road Map for Success

BusinessMAP merges data with maps to help you keep your finger on the pulse of your business. —By Bruce Brown

Environmental Systems Research Institute's \$99.95 BusinessMAP 2.0 is a sales and marketing tool used to meld data from business applications with maps. A relatively approachable GIS (Geographic Information System) product intended for business users, BusinessMAP is an excellent way to analyze geographic information and build and maintain business.

Any data with readable GIS data points can be placed on maps; ZIP codes are the most common information used to position data on a map. This recently updated version of BusinessMAP includes complete U.S. street data and a separate CD-ROM with ABI's American Yellow Pages.

To use BusinessMAP, you import data from contact managers, databases, or spreadsheet files into maps as layers. You can add



MAP MAKER: BusinessMAP imports data from applications and graphs it in easy-to-edit layers.

and manipulate up to 256 layers of data. During testing, we integrated data from an Excel spreadsheet with regional sales and contact information on a

U.S. map. By scanning the map, we could instantly tell which sales people were our best sellers and which ones needed extra encouragement.

BusinessMAP reads ACT! and TeleMagic contact manager files, dBase and Microsoft Access format database files, plus Excel and Lotus 1-2-3 spreadsheet files. For those working from more traditional mapping applications, the program can also work with GIS shape files and MapInfo .MIF files.

BusinessMAP is designed for people who aren't mapping experts and don't care to become GIS gurus. The program shouldn't be confused with full-blown GIS applications, such as ESRI's own ARCView or MapInfo. Instead, what you get is simple data points on maps, but you

can use those points to create charts, tables, and reports. The program includes a helpful tutorial, but becoming proficient at the complicated task of mapping still requires some practice.

BusinessMAP, which comes on both floppy disks and two CD-ROMs, includes map data for countries; cities; highways; area codes; U.S. congressional districts; and U.S. states including highways, ZIP codes, and streets.

Given its integration with popular business applications and its reasonable learning curve, BusinessMAP 2.0 will add a whole new dimension to your data.

BusinessMAP 2.0. List price: \$99.95. Requires: 4MB RAM; 13MB hard disk space; Microsoft Windows 3.1x, Windows 95, or Windows NT. Environmental Systems Research Institute Inc., Redlands, CA; 800-970-0033, 972-664-0456; www.esri.com. *Circle 404 on reader service card.*

WEB UTILITIES

WebSeek and Ye Shall Find

If it's out there, WebSeeker 2.0 will help you find it by querying numerous search engines —By David Haskin

With Web search engines, finding too many sites can be as frustrating and time-consuming as not finding enough. ForeFront's \$49.95 WebSeeker 2.0 is a powerful if unpolished tool that solves both problems.

Like Iconovex's EchoSearch and Quarterdeck's WebCompass ("The Ultimate Utility Guide: Internet Search Tools," May 14, 1996), the 32-bit WebSeeker can query multiple search engines and generate useful reports. While EchoSearch is limited to seven search engines, WebSeeker can query as many as 23 simultaneously. After completing a search, WebSeeker creates an Xbase-compatible database file with the hyperlinked results.

WebSeeker has many other

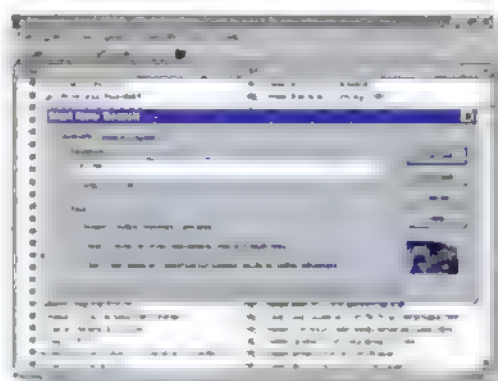
search tricks up its sleeve. Duplicate site listings are automatically eliminated. When you repeat a search, WebSeeker displays addresses located during prior searches that are no longer valid.

To help you quickly find the specific information you want, WebSeeker can download and index the text portions of matching pages. To fine-tune the results, you can search the index created by WebSeeker for a second term or phrase. For example, if you initially queried for "Mexican food recipes," you could search the indexed results for sites containing the words "chili and cilantro." In contrast, EchoSearch uses a filter to narrow the possible search results on the fly; you can expand them by, say,

adding the search results for "Tex-Mex recipes" to the original query.

WebSeeker offers a lot of search power, but it also has some rough edges. One annoyance is that you must rerun the entire search even if you only want to verify whether site addresses are still valid. Because WebSeeker performs such tricks as removing duplicates by default, these searches take a long time, particularly across multiple engines.

On our tests with a dial-up



SUPER SEARCH: WebSeeker can automatically eliminate duplicate sites, remove invalid addresses from previous searches, and create indexes.

connection, WebSeeker required 20 minutes to complete a search for a single word using 23 search engines. It required almost four hours to download and index the 1,500 found pages. During that time, our 90-MHz Pentium test machine with 16MB of RAM was frustratingly slow. WebSeeker's built-in scheduler can perform search operations at specific times—overnight, for instance.

Despite needing some refinement, WebSeeker is an impressive tool that enables you to cast a wide net on the Web.

WebSeeker 2.0. List price: \$49.95. Requires: 8MB RAM, 10MB hard disk space, Microsoft Windows 95. ForeFront, Houston; 800-653-4933, 713-961-1101; www.ffg.com. *Circle 403 on reader service card.*

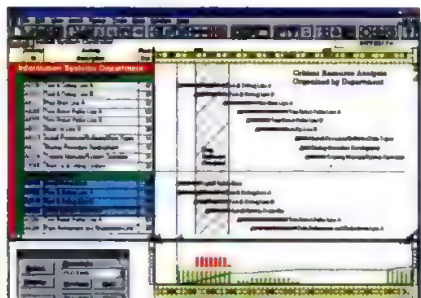


Join Us Online
from December 2 to 6
to discuss WebSeeker
with reviewer David
Haskin.

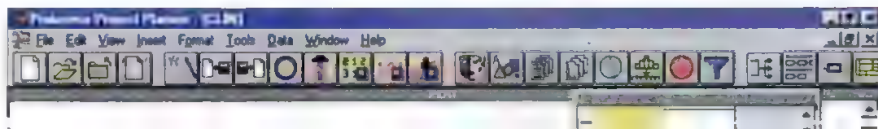
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SCANNERS

Scanning on the Cheap

A 24-bit flatbed scanner for \$300? Check out the Nikon Scantouch 110.—By Daniel Grotta and Sally Wiener Grotta

The \$300 Nikon Scantouch 110 stands out from the crowd of inexpensive, color flatbed scanners with an enviable combination of moderate resolution, simple operation, a superior interface, a good assortment of software, better-than-average image fidelity, and a hard-to-beat price tag.

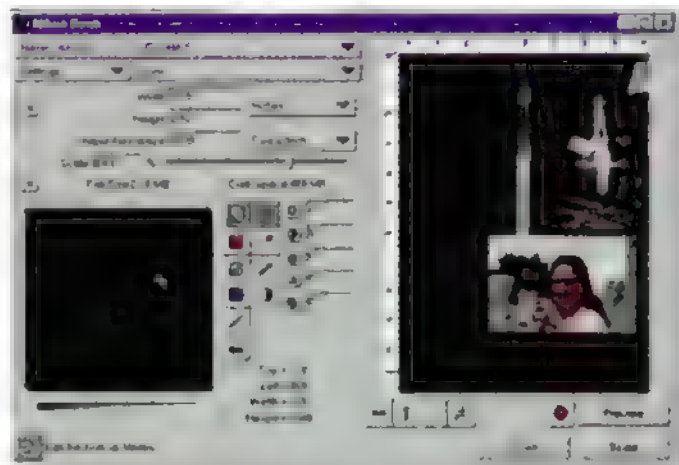
Everything you need is included: SCSI board, cable, terminator, Twain driver, and Photoshop LE and OmniPage LE OCR software. The Scantouch 110 can work with up to 8.5- by 11-inch originals, and a transparency head is available (but it costs as much as the scanner does).

A one-pass, 24-bit device with an optical resolution of 300 by 600 dots per inch (dpi), the Scantouch 110 uses interpolation to enhance images up to 4,800 by 4,800 dpi. The Scantouch 110 uses the same interface as the company's more precise—and expensive—flatbed and film scanners. The system includes a full complement of prescan features and can perform crop, zoom, resize, sharpen, contrast and brightness, flip, rotate, auto-exposure, and white point/black point functions, among others.

During evaluation, we found it easy and efficient to adjust color, contrast, and dynamic range on either the software's editable gamma curve or the RGB/gray-scale slider controls. We also had no trouble instantly displaying the image information as a histogram. Though we liked the interface, we found it frustrating that some of the values (such as cropping) had to be reset every time we set up a scan.

We were able to configure the Scantouch 110 to scan an 8- by 10-inch color original at the maximum resolution (which would

produce a 6.5GB file), even though our computer didn't have enough disk space to accommodate such a large file. The result was an unrecoverable system



LIKE THE PROS: The Nikon Scantouch 110's software includes many features usually reserved for professional scanners.

error. Once we lowered the scanning parameters to a more reasonable size, though, the scan went off without a hitch.

The quality of the Scantouch 110's output was excellent from

start to finish. We found that the typical 1,200-dpi interpolated scan produced an image that was significantly more detailed and brighter than the 300-dpi optical scan that it was based on. Scanning at resolutions above 1,200 dpi produced larger files but not necessarily better images.

Nikon boasts that the Scantouch 110 can scan an 8.5- by 11-inch document at 300 dpi in less than 24 seconds. But the fastest speed we achieved on our Pentium/150 system with 64MB of RAM was 2 minutes 9 seconds.

Despite its slowness and occasional inconveniences, the Scantouch 110 produced images that were consistently sharp, and colors that were fairly accurate without being washed out or oversaturated. We saw very little aliasing or artifacting across a variety of originals. And although it appeared soft, we could easily read 2-point type

from a scan of our test target.

There are several things that distinguish the Nikon Scantouch from comparably priced flatbed scanners from Epson, Plustek, and Umax. One is its maximum interpolated resolution: Most 600-dpi optical resolution scanners go up to 2,400 dpi; the Nikon's software supports up to 4,800 dpi. Nikon uses the same interface for all its film and flatbed scanners, including its high-end units that sell for \$12,000. This gives the Scantouch more robust, professional-style tools and functions for tweaking and improving images.

Compared with the multitude of inexpensive scanners available, the Scantouch 110 stands out. It is especially appropriate for the small-office or home user requiring a scanner that is equal parts quality and value.

Nikon Scantouch 110. Estimated price: \$300. Requires: 8MB RAM (20MB recommended), 300MB hard disk space, Microsoft Windows 3.1 or later. Nikon Inc., Melville, NY; 800-526-4566; www.nikonusa.com. Circle 407 on reader service card.

UTILITIES

Resizing Dialog Boxes

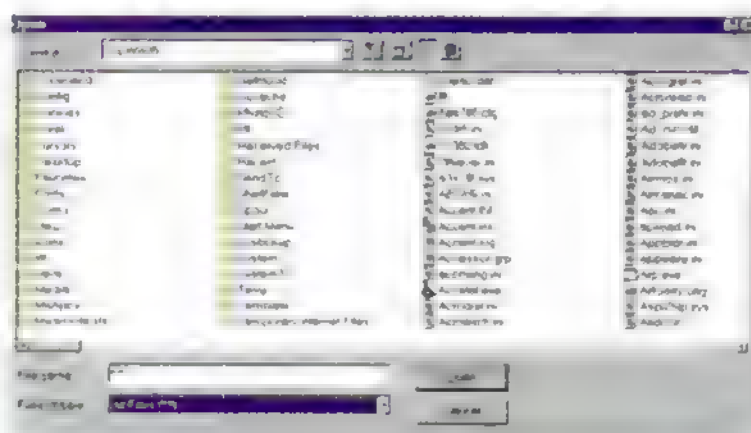
This inexpensive Windows 95 utility gives dialog boxes room to breathe.—By Barry Simon

When it comes to making computing more pleasant and productive, little things mean a lot. Eric Askilrud's Let Me See 1.1 allows you to resize, control, and customize Microsoft Windows 95 dialog boxes to show a greater variety of file possibilities. This shareware gem can be downloaded from weber.u.washington.edu/~redlense/win95.html.

Most Windows 95

THE BIG SQUEEZE: Let Me See allows you to resize your dialog boxes from standard fare (top) to enhanced size (bottom).

programs use standard dialog boxes (which occupy 500 by 150 pixels) for performing File/Open



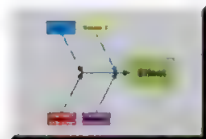
and File/Save operations. Let Me See allows you to enlarge the box several times over to show more entries or more detail.

For example, using a PC with a screen resolution of 1,024 by 768, we set up the program to display 800- by 300-pixel dialog boxes, which is more than three times the size of the standard Windows 95 dialog box. This was enough room to display 64 files in list mode and 16 files in details mode—about twice as much material as the standard box would allow.

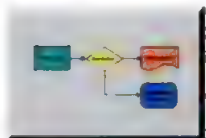
As good as Let Me See is, it still can't touch the nonstandard dialog boxes used by Microsoft Office. Nevertheless, simple, focused, and powerful Let Me See is a utility that belongs on your PC.



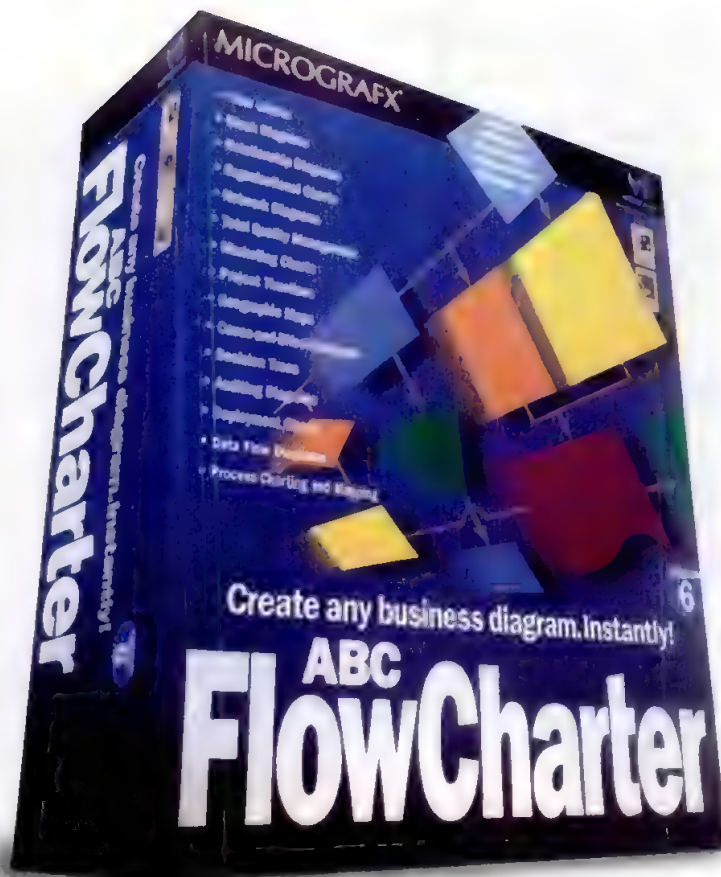
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First Looks

WEB DEVELOPMENT

Point-and-Click Web Sites

IntraBuilder offers a solid foundation for building interactive Web sites via JavaScript. —By Jay Munro

Borland's \$499 IntraBuilder Professional synthesizes past and current technologies into a powerful suite of object-oriented tools for building interactive Web sites. While there's no shortage of competent Web database development products ("Building Your Own Web Site," September 10, 1996), IntraBuilder is unique in that it uses JavaScript as both a

tables, forms, and reports using IntraBuilder's Experts or use the Designer to create objects from scratch.

To create and deploy an application, you need Microsoft Windows 95 or Windows NT, a TCP/IP connection, a Web server, the IntraBuilder application server, a database, and IntraBuilder application code. IntraBuilder supports Microsoft, Netscape, and most CGI-compliant Web servers. IntraBuilder comes with

Form Designer uses live data during design, so you get a better idea of exactly how the application will look.

Microsoft SQL Server, and Paradox, as well as ODBC connectivity for use in the Visual Table Builder. The forthcoming Enterprise Version of IntraBuilder promises native IBM DB2, Informix, Oracle, and Sybase drivers.

To use SQL data sources, you must configure a driver and an alias in the BDE. Configuration requires more work than it does with such products as Macromedia Backstage, which recognize ODBC sources immediately. IntraBuilder lets the developer set security at the session, database, and table levels (on .DB and .DBF tables). Custom security schemes can be developed in JavaScript. IntraBuilder also logs user information that can be used to implement automatic security and auditing.

You can create tables from scratch using the Table Designer module in Visual Table Builder (VTB) or select from over 25 predefined table templates with Table Expert. Within Table Designer, the developer can add indexes, primary key files, and referential integrity (depending on the database).

Visual Form Builder (VFB) walks you through form creation using your table's schema as a guide. With Expert, you can create columnar or free-form

pages, methods, and events much as Delphi and Visual Basic do. IntraBuilder supports nine popular image formats.

Visual Query Builder (VQB), a module licensed from Integra Technology International, provides drag-and-drop query design. Tables are selected when you first open VQB. We found that with SQL tables you need to log on to the SQL database with the Tables tab first to see the tables in VQB. Paradox and dBase tables are single-file based and do not need to be opened first. To build most queries, no knowledge of SQL is required, thanks to the preset options for count, average, and minimum and maximum of data, as well as a visual expression builder. For SQL gurus, IntraBuilder also lets you create queries with the SQL Statement Editor.

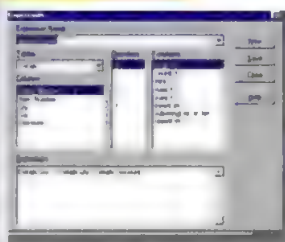
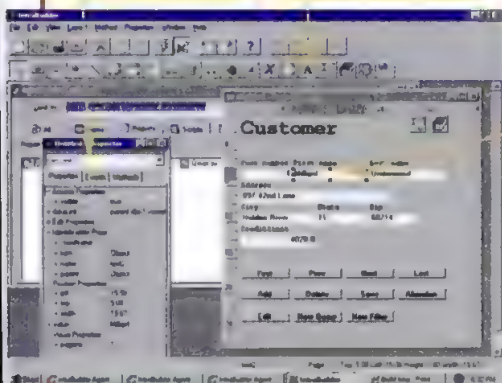
Visual Report Builder (VRB) creates reports that can be run directly from your Web site or linked to your Web pages. The VRB design environment works with live data from your table or query to give a good feel for the information. Report Expert walks you through table and query selection, field selection, grouping, summary information, and tabular or columnar style. Reports can be customized with additional queries, images, text, and graphic elements in Designer.

IntraBuilder, like Macromedia Backstage, lets developers create interactive sites visually. In short, Borland's IntraBuilder is a powerful and impressive suite of easy-to-use tools for creating interactive database Web sites—all at a bargain price.

Borland IntraBuilder Professional, Version 1.0. List price: \$499. Requires: 12MB RAM (with Windows 95) or 16MB RAM (with Windows NT), 30MB hard disk space, Microsoft Windows 95 or Windows NT 3.51 or later. Borland International Inc., Scotts Valley, CA; 800-336-6464, 408-461-9000; www.borland.com. Circle 409 on reader service card.

Form Designer Inspector lets you set properties, events, and methods on your forms.

Tool palettes provide quick access to database and query controls.



FREE-FORM DESIGN: Form Designer is a drag-and-drop environment with rulers, a customizable snap-to grid, and alignment tools (left). Visual Query Builder's Expression dialog box lets you build calculated fields using preset functions (right).

scripting language and a source for forms and reports.

When a user browses your application, the JavaScript code runs on the IntraBuilder server and is rendered as an HTML form on the fly. The key to IntraBuilder is its JavaScript extensions—literal arrays, code blocks, exception handling, database classes, subclassing, and object inheritance. Application projects are managed from the IntraBuilder Explorer, a tabbed list of project objects with full drag-and-drop support. Developers can quickly create

Netscape FastTrack server for deployment and Borland's Personal Web server. IntraBuilder supports CGI, ISAPI, and NSAPI, as well as client JavaScript and HTML. As a bonus, the Borland AppAccelerator, a JIT (just-in-time) compiler, is loaded with FastTrack to perk up Java performance.

The BDE (Borland Database Engine) is the core of IntraBuilder and it controls data access during development and deployment. The package comes with native drivers for Borland's dBASE, InterBase,

forms, with navigation options and a choice of color schemes.

Building forms is simplified by IntraBuilder's Form Designer, a drag-and-drop environment with rulers, a customizable snap-to grid, and alignment tools. Dockable tool palettes bring database and query controls, data-aware buttons, list boxes, text, password and picture controls, and support for ActiveX and Java applets. Developers can also create their own custom controls and put them on the toolbar. A tabbed dialog box exposes property



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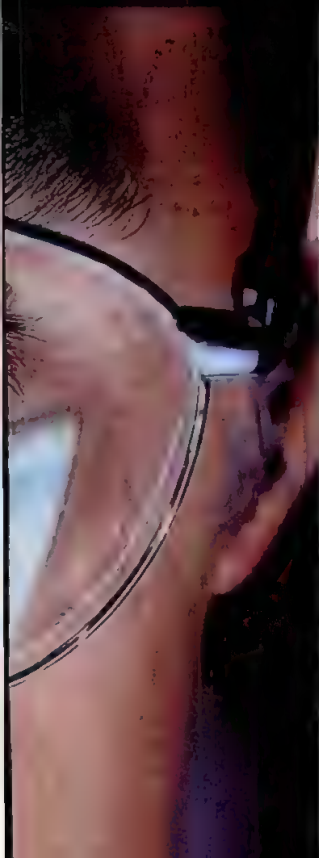
Look left. Look right. When was the last time you had to do that to see everything on your screen? We thought so. Small screens are great for hand-held TVs. But for computers running today's applications, the bigger the screen, the more information you see and, chances are, the more productive you are.



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It has features that will put it high on the wish list of everyone in the company. The larger screen means applications won't have to be scrolled back and forth so much or reduced to eye-straining proportions. It also has an extremely fine dot pitch and high resolutions for crisp, sharp images and on-screen controls that allow for very easy and precise adjustments. What's more, the highest refresh rate in its price range keeps the screen flicker-free. In fact, for the money, you won't find another monitor with such an impressive list of features. Go ahead, look around. For more information, call 1-800-818-9088 or visit us at www.compaq.com.

COMPAQ

Has It Changed Your Life Yet?

First Looks

CONTACT MANAGERS

Organizer Goes Online

This 32-bit Day-Timer Organizer works with your e-mail client and your Web browser—By Rick Broida

Day-Timer Technologies meets the online world head-on with its \$59.95 Day-Timer Organizer 2.1. This version has the familiar look and feel of its paper-based counterpart but adds Internet and e-mail as well as support for 32-bit applications.

The program is now 32-bit itself; the 16-bit version is also included in the package. Newly added Internet support lets you launch your Web browser from within any contact listing, and you can send e-mail to a contact just by clicking an icon. But because Organizer recognizes only VIM- and MAPI-compliant messaging systems, you can't send mail via Navigator or Juno. Furthermore, Organizer lacks GoldMine's ability to capture and import data from the Web.

The program also adds mailmerge support for 32-bit word

processors. You can add alarms to scheduled phone calls and assign titles to notebook entries. New printing options include report titles, headers and footers, and the ability to print a range of addresses. Organizer now has a quick-fill feature, which recognizes the first few letters of your entry and fills in the rest for you.

Organizer's drab interface could stand a face-lift, but it delivers unbeatable functionality and ease of use. The various scheduling and contact lists are contained in separate windows, allowing you to customize the view. The toolbar atop the screen remains constant no matter which window is active.

In addition to drag-and-drop scheduling capabilities, Organizer offers automatic conflict checking and pop-up alarms. Double-clicking a contact record

opens a well-organized information window, with tabbed dividers for addresses, phone numbers, notes, meetings, and calls. Like GoldMine, Organizer has tabs for attaching external files and for linking entries.

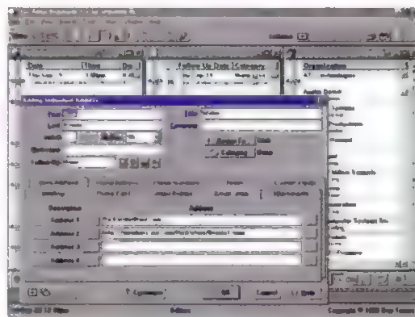
Both the Windows 3.x and Windows 95 versions support single- and multiuser databases, and offer cross-platform compat-

One shortcoming is Organizer's limited number of import filters: only other Organizer databases and ASCII files are supported; the \$49 upgrade package includes an IntelliLink import filter. And the program is now much faster at importing ASCII text; it took just over 3 minutes to bring in 1,000 records.

While it lacks the simplicity of Starfish Software's Sidekick and the robust sales tools found in GoldMine, Day-Timer Organizer 2.1 delivers an excellent mix of contact management, scheduling, and Internet features. **Day-Timer Organizer 2.1.** List price: \$59.95.

Requires: 4MB RAM, 6MB hard disk space, Microsoft Windows 3.1,

Windows 95, or Windows NT. Day-Timer Technologies, San Mateo, CA; 800-225-5005; www.daytimer.com. **Circle 402 on reader service card.**



BEST OF BOTH: Day-Timer Organizer 2.1 combines the ease of use of a paper-based organizer with useful Internet features.

ibility with the Macintosh. Also available is a workgroups edition that lets you schedule meetings and allocate tasks among several individuals and share contacts.

UTILITIES

Zip It and Forget It

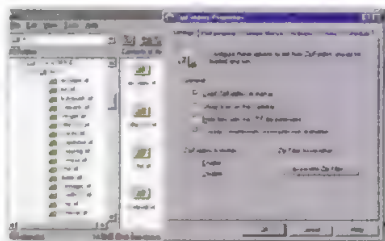
Managing and using .ZIP archives with ZipFolders 1.0 is so easy it's almost invisible.—By Edward Mendelson

ZIP archives are the standard file format worldwide for storing and transmitting one or more files in compressed form. ZipFolders 1.0 makes using .ZIP files as easy as managing as any other files on your disk.

This spectacularly innovative utility from Mijenix Corp., priced at \$30, makes Microsoft Windows 3.1 and Windows 95 treat all the files contained in a .ZIP archive exactly as if they were in an ordinary folder. .ZIP files become so accessible that you can use your word processor to edit a file stored in a .ZIP archive and then save the revised version directly. You can run a program stored in one .ZIP archive and

use it to edit a file stored in another archive, although this process is much slower than it is with uncompressed programs and files.

All other .ZIP management



CAREFREE COMPRESSION: ZipFolders tricks the computer by assigning .ZIP archives a .ZIF extension. All the program options are accessible from the Properties dialog box.

utilities merely list the files in a .ZIP archive or display them in an Explorer window; they let you view or run them one by one. ZipFolders operates as a device driver that tricks the Windows file system into working as if a .ZIP archive named PCMAG.ZIP is also a folder named PCMAG.ZIF. When you run or open a file in that virtual folder, the device driver expands the file transparently. A control panel lets you decide whether to view both the .ZIF folder and the .ZIP file or only the .ZIF folder in the Explorer and File/Open dialog boxes.

For all its power, ZipFolders is amazingly well behaved, customizable, and unobtrusive. You can turn it on or off, or schedule a time when it turns itself off automatically so that you can run defragmentation and backup utilities without

making them process both the .ZIP file and the .ZIF virtual folder. You can even associate the .ZIP file extension with such traditional .ZIP manager software as Nico Mak Computing's WinZip, and still enjoy all the features of ZipFolders. While Version 1.0 lets you compress the contents of a folder by adding the extension .ZIF to the folder's name, it cannot create encrypted .ZIP archives. Version 1.1, due out by the time you read this, will add support for .ZIP archives that span multiple disks and will create encrypted .ZIP archives.

Simply put, ZipFolders is one of the best utilities ever written, and no one who uses .ZIP files should be without it.

ZipFolders 1.0. Street price: \$30. **Requires:** Microsoft Windows 3.1 or Windows 95. Mijenix Corp., Madison, WI; 800-645-3649, 608-277-1981; www.mijenix.com. **Circle 401 on reader service card.**



August 1986
PC Magazine
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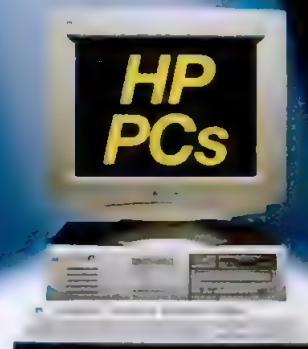


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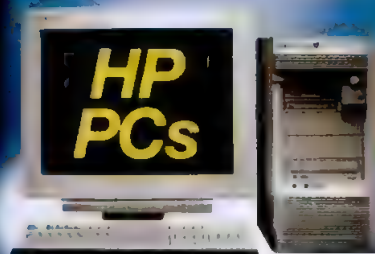


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- Free three-year limited warranty for parts and labor

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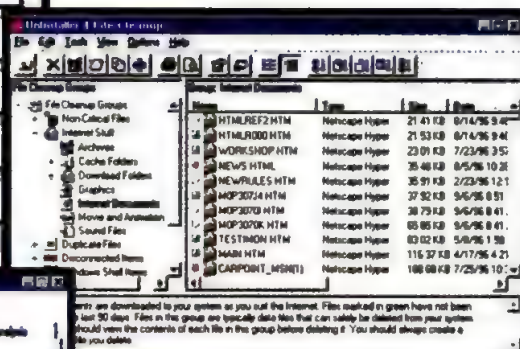
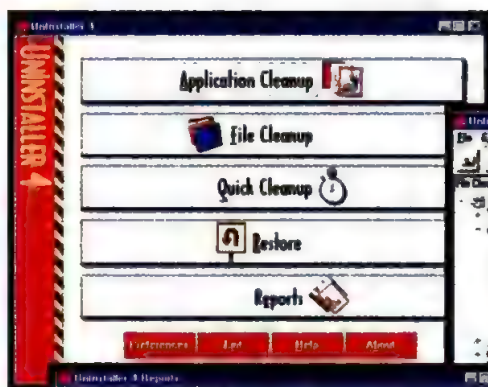
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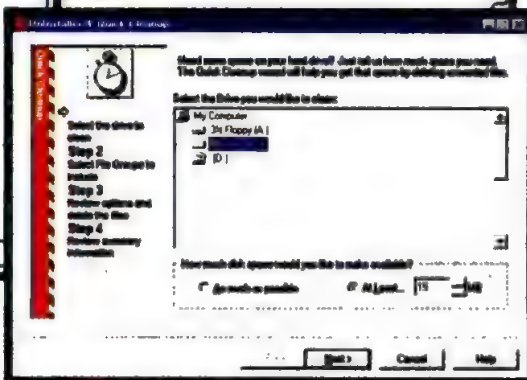
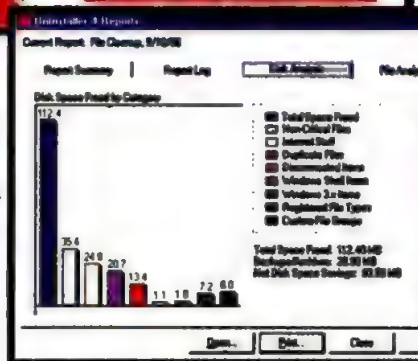
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HEY, EVERYONE CAN USE A LITTLE HELP.

CIRCLE 214 ON READER SERVICE CARD

Second Looks

DATABASES

The Solution of the Century

As December 31, 1999 approaches, we're likely to find that more and more programs won't be able to adjust well to life in the new century. The reason is that many programmers still use a trick from mainframe days: To save memory, they designated two characters to represent the year; 1995 would be entered as 95, with the 19 being assumed. This predicament becomes critical after New Year's 1999, when the program will think 00 means 1900, not 2000.

While this is a major headache

for mainframe programmers, it also affects some Microsoft

Windows stalwarts, and several PC programs will undergo melt-

down just after the champagne corks are popped. That is, unless things are fixed in the interim.

Some Windows applications written in Microsoft Access will suffer from this form of calendar lock. Fortunately, Access developers can avoid the problem with an easy workaround. Start by

adding a procedure to the field's AfterUpdate event that checks the year. If the last two digits of the year are 00 through 49 (corresponding to the years before 1950), then add 100 years to the date. Try this out with a few sample dates to make sure it works under a variety of conditions. You can get more information and other potential fixes by searching the Microsoft Knowledge Base on its Web site (www.microsoft.com).

This fix is temporary but long-lasting, because it buys you 100 years of data entry grace. By then you'll probably be using a more calendar-friendly version of Access or a more advanced database program.



OFF-LINE BROWSERS

FreeLoader: Still Free, But It Loads Better

In our initial review of FreeLoader, we praised the concept of an advertiser-sponsored, off-line Web browser (First Looks, August 1996) that could venture onto the crowded Internet, gather what you need, and then present it inside your favorite browser. But FreeLoader 1.0 forced you to store your cached Web pages in one of 14 categories, making it too rigid to adapt to a rapidly changing Web.

All that has changed with a re-

vamping of FreeLoader that makes the program the premier way to work the Web off-line. We looked at beta 21 of FreeLoader, which we downloaded from the company's Web site (www.free-loader.com). Overall, the program was rock-solid and feature-complete, but it seemed a bit slow during download sessions; the final release should be ready by the time you read this.

FreeLoader's big improvement is customizable categories

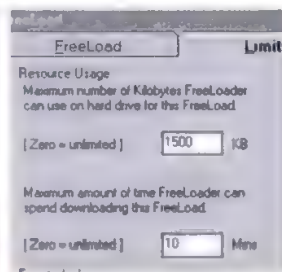
—or as the program calls them, channels—for your off-line Web viewing. This is in addition to the 15 preset channels for such areas as Science and Health, and Family Life. The more you use FreeLoader, the more you'll appreciate this new-found flexibility.

FreeLoader also approaches the abilities of programs like



PointCast in its capability to grab and present news, weather, stock quotes, and Internet-related information automatically. Unlike the previous version, which forced you to perform a download each day whether you wanted it or not, the new version can

While FreeLoader lets you set limits on how much disk space it fills and the length of its Internet excursions, setting either of the limits to zero means no limit at all—a counterintuitive scheme that will likely confuse many users. And the space in the middle of the screen for displaying information is squeezed into a nar-



row ribbon between the browser's toolbar at the top and FreeLoader's bar at the bottom. This drawback is particularly noticeable on VGA screens.

Nevertheless, FreeLoader breaks a basic rule of Marketing 101: It gives you more—much

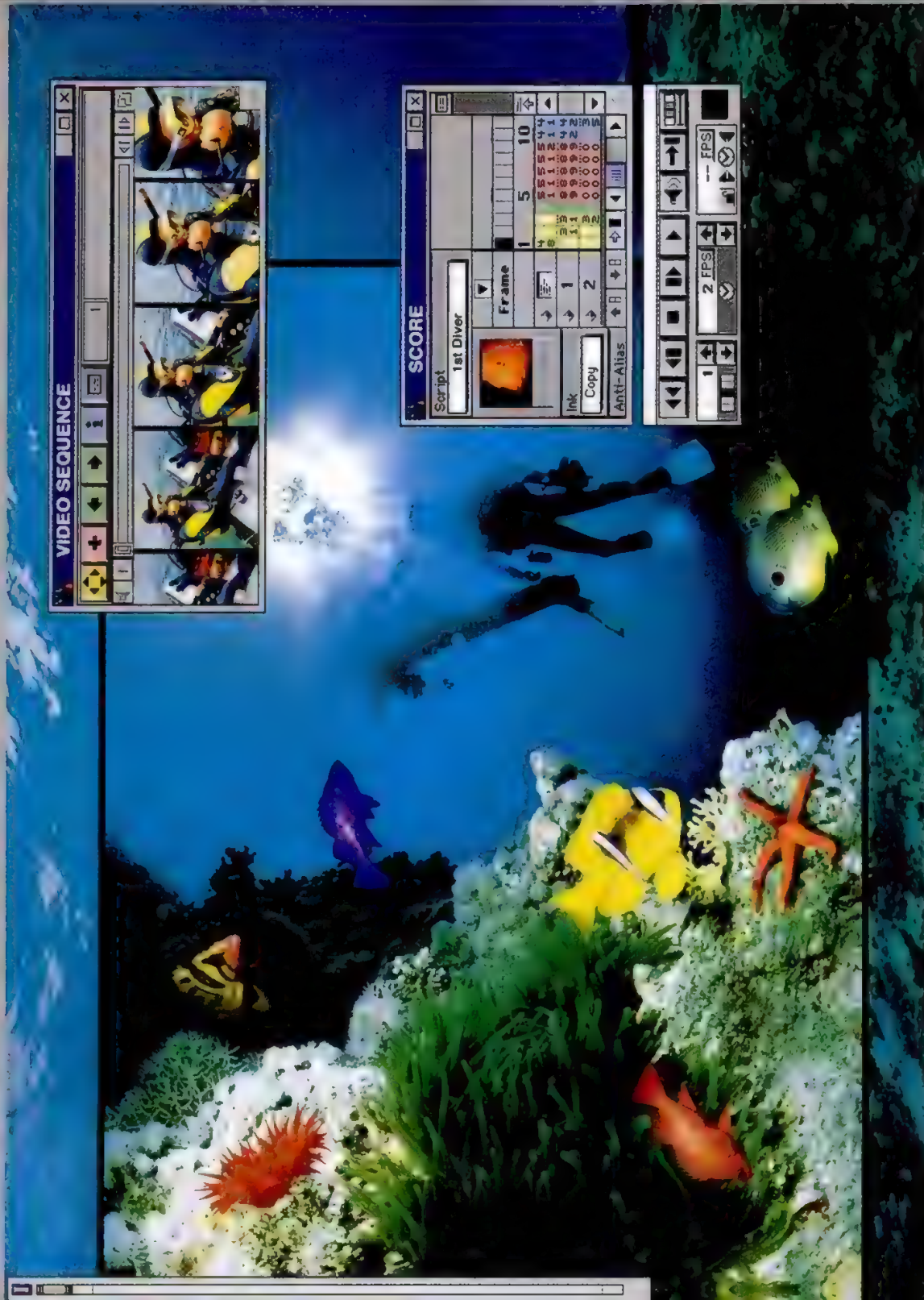
BUG BRIEFS

Problem: If you use CleanSweep 95 and install Microsoft Internet Explorer 3.0, CleanSweep may cease to work. If you replace the offending files (ADVAPI32.DLL and OLEAUT32.DLL) with older versions, CleanSweep works again, but IE 3.0 probably won't.

(Actual size)

Adventure

Cast Score Text Help



cor 4.0

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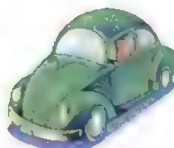
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Soothing the Savage Beast—Digitally

Music is making itself heard in the Machrone household once again. As usual, it's digitally assisted. For the past several months, I've been using the latest version of Band-in-a-Box for Windows, 7.0. I hadn't upgraded the program since DOS 4.0,

and it turns out that I'd missed quite a lot of progress in the intervening versions. Band-in-a-Box was a finalist for a *PC Magazine* Award for Technical Excellence back in 1989, and it's gotten progressively better over the years.

Band-in-a-Box (PG Music, 604-475-2874; www.pgmusic.com), you'll recall, is the original music accompaniment program for the PC (and Mac). You key in a series of chords, select a musical style, and it orchestrates keyboard, drums, bass, and guitar lines. It's the ideal accompaniment for singers and solo musicians, and it has the endearing virtue of never getting tired of playing the same thing over and over again, complete with endless tweaks in styles, instruments, balance, and tempo.

BB has gotten considerably more sophisticated over the years, especially in the area of styles. Not only does it have all the rock, pop, ethnic, and folk styles you could ask for, but it's especially rich in the area of jazz styles. In addition to the regional, historical, and ethnic jazz styles you'd expect, BB now has styles for individual performers. So your accompaniment sounds can be as diverse as Fats Waller to Django Reinhardt, Herbie Hancock to Wynton Kelly. These sounds are amazingly good. A friend of mine who makes his living playing jazz piano has profound respect for BB's styles.

BB gained the ability to record and play back melodies a couple of versions back. Now it can create harmonies, too. A simple melody line becomes an arrangement for an entire horn section at the touch of a button. It can even display lyrics while playing a song. But the icing on the cake is "automatic solos," where BB generates solos based on a musician's style. And yes, you can change the parameters in the Soloist Maker module to your liking.

In our issue of October 8, I wrote about the first PDA for musicians, the Roland PMA-5. It's intriguing to compare the PMA-5 to BB. The PMA-5 has fewer features overall but sounds better than BB, even if you have a wavetable-equipped sound board in your PC, a virtual necessity for any serious musician or gamer. The PMA-5 has a bigger library of sounds, and its accompaniments are richer, more profes-

sional sounding. The PMA-5 is utterly portable, but its small screen and idiosyncratic user interface can be frustrating. BB, on the other hand, lets you build a song as quickly as you can key in the chords. It works perfectly well on a notebook, so it, too, can be portable. But you'll need an external synthesizer,

such as a Roland Sound Canvas or the SCP-55 PC Card, to get maximum quality.

But maybe you're not quite ready for the spotlight—perhaps you need to learn to play your instrument better. PC-based instruction programs have become markedly better in the past year. Two interesting CD-ROMs I've seen recently are eMedia Guitar Method (eMedia Corp., 206-329-5657) and Jazz Tutor (Masterclass Productions, 201-670-7079).

If you're a beginner, you'll enjoy eMedia Guitar Method for its relaxed, strum-and-sing orientation. Production values are not the highest, but Guitar Method takes you through the basics, from stringing and tuning your guitar to playing a number of classic folk tunes, and even covers some basic rock power chords. It teaches guitar the way I used to, in college, to high school and junior high kids who wanted immediate results. This is a great way to get started; the pain in your fingertips will be the only thing to hold you back.

Jazz Tutor is vastly more ambitious, featuring the renowned sax player Phil Woods. There's enough material here for years of study, from modal scales to jazz harmonies to Phil Woods' life to

play-along MIDI files. It transposes for piano, treble horns, and woodwinds, but a trombone player is out of luck unless you pull the MIDI files off the CD and transpose to bass clef with a sequencer program. This is a slick, polished production, with excellent voice-overs, well-written instructions, lots of music to listen to and learn from, and plenty of places to play along—at your own speed. I was especially impressed with the scale and chord reference pop-ups: The program shows the underlying theory and practice behind what you're hearing and playing. Even if you don't play an instrument, Jazz Tutor can give you a whole new appreciation for the complexities and fine points of jazz. □



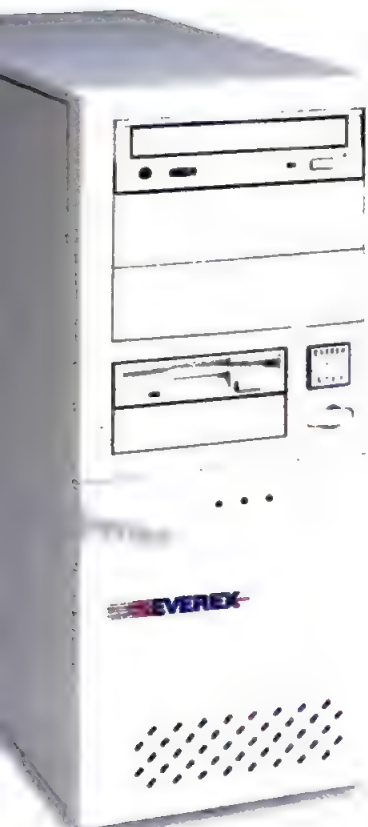
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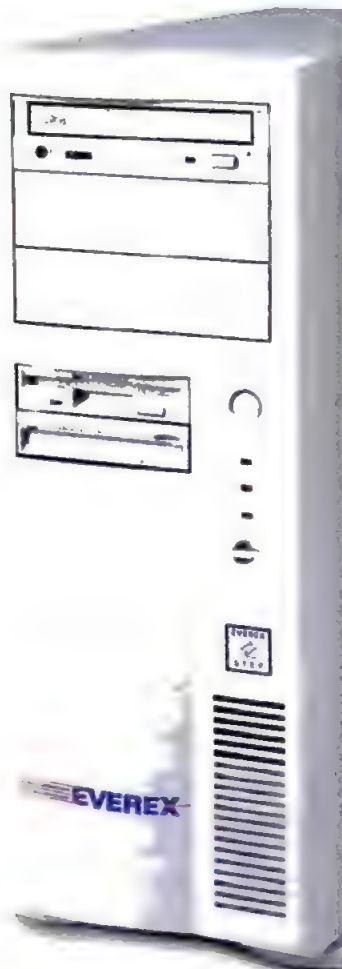
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Top Ten Laptop Laments

As someone who travels a lot (possibly to excess), I require a laptop. I tend to use the laptop du jour, as agreed upon by three or four other folks and myself. This is nothing done consciously but something that arose out of a curious coincidence. When Bill

Machrone was editor-in-chief of *PC Magazine*, every so often we'd compare notes about our top preferences, and it always seemed we were using the same equipment. The same thing happened with Michael J. Miller, the current editor-in-chief. Today, we both use the IBM ThinkPad 560.

Before that we used the Toshiba Portégé, which I have no trouble recommending.

Though laptops continue to improve, I still find general faults that merit some discussion. Here are my top ten complaints about today's laptops:

1. Accidental power-on. This is the worst of the problems, and the Portégé, among the top performers in other respects, was always the worst of the worst. The Portégé has a weird hair-trigger button that can be bumped easily, turning the machine on even though the lid is closed and it's not hooked up to an external monitor. The ThinkPad 560 is slightly better, but it too can accidentally be powered-on and go dead with the lid down. There is nothing worse than reaching for your laptop only to discover it's been running and is now dead—right when you're looking at 2 hours on an airplane. Vendors, please fix this problem! Start by getting rid of the outside push button.

2. Spillage. The technology is available to make keyboards waterproof. This can be a serious problem on airplanes when flight attendants pass soda over your computer. A Nikon camera is waterproof. Why can't these machines be, too?

3. Little pieces. Why do laptop makers insist on adding separate little pieces to the design that are forever being lost? You can always spot a person who uses a laptop a lot. All the little pieces are missing and the machine looks terrible. The most recent example is the rubber port cover on the ThinkPad 560. It's gone in a matter of days.

4. Modems. I complained about the lack of internal modems before but was told that dealers like the value-added sales and therefore forced laptop makers to take the modems out. Great. Talk about the tail wagging the dog. The PCMCIA modem, unless it's a Megahertz X-Jack, is a disaster. On most modems, the dongle will get lost or broken. Even the X-Jack is delicate, but at least you can't lose

it. I refuse to use a modem with a dongle. So should you.

5. Standard cells. When will the laptops utilize standard cells for batteries? The ThinkPad 560's battery pack looks like standard cells (AA batteries) encased in an expensive package. Standard cells would allow travelers to buy batteries at

the airport for long trips or in an emergency. Currently, there's no way to use your machine in an emergency if the factory battery is dead, and you have no source of power. The Taiwanese tried to implement a standard cell approach a few years ago, but to no avail.

6. TV set in a laptop. Where is the cheap TV tuner for the laptop? This is another issue I've harped on, without result. I want to watch TV once in a while on my laptop when traveling.

7. Higher output resolution. The VGA output for a laptop should be at least 1,280-by-1,024. All it takes is a little more video memory. Let's do it in high color, too.

8. Caps Lock key. There is no need for a Caps Lock key on any computer, let alone a laptop. Who uses it? No one. Get rid of it.

9. Lid illogic. Can't laptop makers get it together on how the lid closure should work? When you close the lid, the machine should go into suspend mode so it doesn't kill the battery. But if the ports are being used (keyboard and VGA out), then the machine should assume it should stay running and send display data out of the port. Under no circumstance should the LCD display be running with the laptop lid closed. Still,

most laptops operate like this. What's the point?

10. Suspend function. What's wrong with this feature? I have yet to use a laptop for more than six months without this function failing. On the first Portégé, which introduced a bookmark feature three or more years ago, the suspend function simply failed to work after about four months. This has happened with every laptop I've had, except the Portégé 610. Recently, Windows 95 has been crashing whenever I hit Suspend on my ThinkPad 560. It's ridiculous to have to continually reinstall this OS. What is the problem? Whatever the case, there should be some way to stabilize this bookmark/suspend function so that it's not dependent on Win 95.



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Inside Track

Looking to the next generation: According to published reports, Intel's first MMX-enabled Pentium Pro will be a **233-MHz chip** capable of full MPEG-2 decoding (including DVD decoding) as well as an array of audio functions, including Dolby sound done in software. The way this Dolby thing has suddenly cropped up is mysterious. I'm still not sure of the significance. Anyway, on a similar note, it appears that by the time it is released, the P7 will be able to **encode** MPEG-2, which takes some serious power.

While Intel is coasting, the competition hasn't yet dropped the idea of catching up. Cyrix kind of caught up, but it never had the marketing muscle of AMD and found itself **locked out** of a lot of deals. AMD is still in the process of catching up after some **dubious design decisions** a while back that veered the company off the fast track. Now AMD is starting to chat up its new 120- and 133-MHz Pentium clones, dubbed the K5-PR120 and K5-PR133. Next on the agenda: the PR166. PR stands for "performance rating," and as with Cyrix machines, the number refers to its "Pentium equivalent" rather than to its actual clock speed.

Personally, I find these numbers—which are used as **marketing gimmicks**—offensive. I wish vendors would simply cite the actual clock speed as part of the name. The marketing benefits of comparing a 120-MHz AMD chip that performs like a Pentium/166 to a 120-MHz Pentium CPU would be tremendous. If you're going to use an arbitrary number based on some dubious equivalency rating, why not just call everything a "200" or "233" and be done with it?

The NC Threat Looms: Meanwhile, Intel and Microsoft have been promoting a concept called "cost of ownership." This refers to the total cost of the machine plus the cost of maintenance and support. The idea is that with things like plug and play you suffer fewer lost weekends and the cost of ownership is therefore low. I have been trying to ascertain why both of these companies seem so **preoccupied** with this notion, which seems to center around the potential of the network computer (NC) to take away market share. But because Intel says it has no interest in the low-end of the business, I don't understand what the fuss is about.

Then I recalled something Brian Dougherty (of Geos fame) was promoting years ago when he predicted that the **next big platform shift** would be from desktops to palmtops. Dougherty described a trend in which a new generation of computers cropped up after a 1-MIPS machine with about a megabyte of main memory took a quantum fall in price. Mainframes became minis, which became micros, which will become whatever as the 1-MIPS trend line continues to achieve lower and lower prices. Surely Bill Gates and Andy

*The smart company
that invents a cheap,
Web-oriented NC
that can be upgraded
later to a full-function
word processor and so
on will eat away
at the Wintel
monopoly.*

Grove are familiar with this theory, and though the **palmtop computer** was a flop (for numerous reasons), the NC fits right into this pattern.

Could I use a network computer? I'm noticing that most of my Web browsing utilizes the printer more than it does the hard disk. I'm printing pages like crazy so I can read them later on the plane or wherever. Schools, libraries, and even families on a tight budget could take advantage of the Web without spending too much. **The smart company that invents a cheap, Web-oriented NC** that can be upgraded later to a full-function word processor and so on will eat away at the Wintel monopoly. These two 800-pound gorillas apparently think this is a possibility—hence, this "new" cost of ownership concept.

In industry, just as in politics, public opinion can be swayed by **cool buzzwords** and concepts that can be turned into catchphrases. Remember the chit-chat years ago about *featherbedding* and *double-dipping*? These terms were used up and replaced with words such as *pork*, a less precise and less evocative term.

The computer business has always had a slew of these selling terms. *Cost of ownership* is one of them. The other side, led by Sun Microsystems, is promoting something called "**thin-client**" computing, which is synonymous with the network computer but is also used to sell Java. The idea behind a phrase like this is that if you start to **use the term**, you've bought into the concept.

The Never-Ending Conspiracy Dept.: Recently, *PC Magazine* lucked into a huge scoop when Hewlett-Packard accidentally sent a computer for testing that had an MMX chip in it. *PC Magazine* Labs tested the chip and found only a **minor performance improvement** on normal apps—something attributed to the system's large cache. The performance boost was about 20 percent—half the increase in raw performance that Intel claims you should get. The bigger question was, How does the chip do when running MMX code? Even those results were nothing special, and this took some of the attention away from the chip.

Because Intel has been annoyed by all the attention paid to the chip in the first place (lest the attention **thwart a difficult marketing plan**), you have to wonder if this "leaked" chip was itself part of a grand scheme. The chip could even be de-tuned to give mediocre results. After all, HP, the vendor that sent us the accidental chip, is Intel's primary partner in the P7. The question I have to ask is, **What was the chip doing in the product in the first place?** And a more interesting question is, How many other magazines had a shot at this chip but simply failed to remove the heat sink and discover an MMX part? Thought-provoking, to say the least. □

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Finally: Crossing the Color Divide

You don't use a black-and-white monitor. You don't watch a black-and-white TV. You don't take black-and-white snapshots. You don't see many black-and-white movies. You live in a world splashed with color, from the natural habitat around you to

the ads, magazines, movies, and other stimuli that surround you. So why do you print out your documents in black and white?

I know: because color is so *e-x-p-e-n-s-i-v-e*. You have that nice, sharp black-and-white laser printer on the network, or sitting by your desk. It's fast; it costs just a few cents a page; it's the obvious choice. Yep, you also have that nice color printer on the network, and you use it once in a while—for printing handouts, perhaps, or a poster for the office bulletin board, or a cover sheet for a proposal, or overhead transparencies, or maybe a color, hard-copy version of a presentation. And every time you do that, you and those who see the color pages are wowed. "You did that on your PC?" they ask. You bask in their praise. And then you go right back to printing everything else in black-and-white.

Because color is so *e-x-p-e-n-s-i-v-e*.

Me, too. Till recently. I've had one or more color printers on the networks in my office for a decade. They've ranged from bad and slow to fairly fast and exceptionally good. But I fell victim, as have you, to the notion that printing in color is so damned expensive, you have to save it for special projects. Often I'd have loved to drop a little color graph or drawing into a letter or report to explain something better, but I usually didn't. That would have meant printing the whole document—even the black-and-white pages—on the color printer so that the different paper required by the color printer and the lower-quality text reproduction didn't jump out at you—a solution that was slow, but mainly just . . . too *e-x-p-e-n-s-i-v-e*.

Then late last summer I was at a technology trade show in the Northwest. Tektronix was showing its new Tek 350 solid-ink color printer. I swear by Tek's earlier, similar 340, so I stopped at the Tek booth to tell the representatives there how much I liked their company's products. I fell into conversation with one of the Tek people, who asked me if I knew how much printing costs had dropped for users of the 340 and the new 350. Tek was trying to confront that "ooh, but color's so expensive" reaction in a creative way: From

now on, for those two printers, black printing would be free.

Huh? Free? "Sure," said the rep. His company was giving Tek 340/350 users all the black-ink sticks they needed, free, to get people to start using their Tek's as their universal printer. That meant color would always be available—

and now even color was cheaper with those printers. Tek cut the price of a set of color-ink sticks in half so that it costs about 3 cents a page to print an ordinary business letter with a little color on it, about a nickel a page to print one of our *PC Magazine* pages with color graphics, maybe 15 cents to print a color newsletter page full of bright color graphics—all the way up to a whopping 30 cents or so for a full-page, four-color graphic. And a black-only page? Free, of course: Remember the free black-ink sticks.

I couldn't stop thinking about that premise on the way home. Black-and-white was free, and color, cheap, so I could start using the existing color printer on my network to print ordinary black-and-white pages for free, and I could start printing color, at a nickel or a dime for one of my typical letter or report pages, without worrying about costs.

I was hooked. Back in the office a day later, I switched my default printer to the Tek 340, and I haven't looked back since. Sure, I change to other printers for some jobs, but in general I've been won over: Color is the norm here now.

Which, of course, was exactly what Tek wanted.

The new Tek 350 is a gem—a 6-page-per-minute, \$3,500 box that prints beautifully on plain paper (try some of the "distressed" recycled sheets, such as Simpson's Evergreen line in the Aspen color, for gorgeous results), networks easily, and switches among Fast Color (economy), Standard, and Enhanced (600-by-300 dots-per-inch) modes. The Enhanced setting produces extremely good-looking black type, even in fairly small sizes. It won't match the best lasers at true 600-by-600 or 1,200-by-1,200 printing, but for business use, it's perfectly acceptable. Like the other Tektronix solid ink machines, the 340/350 are ink jet designs that accept ink in solid bricks—a bit like colored



OVER THE RAINBOW

Sure, I change to other printers for some jobs, but I've been won over: Color is the norm here now.

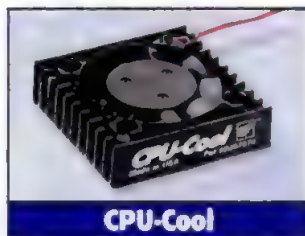
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bars of soap—rather than the liquid used by the majority of other ink jet machines.

But you don't need a Tek printer to discover the quality, convenience, and economy of using color today. An explosion in high-quality, low-cost, color ink jet printers, the result of frantic competition among Canon, Epson, and Hewlett-Packard, means you can buy great color—including very, very good black-only printing—at lower prices than ever before.

Canon, for example, recently introduced several new high-quality, low-cost models, including the diminutive 4200 and the tabloid-size-paper 4550, both of which give great results with their ordinary inks but can also use Canon's special photo inks for extremely good photographic reproduction (more on this in a forthcoming column on digital photography). The Canon tabloid-size printer costs less than \$500 and will knock you out. It's even compact—a charge no one would use about any of its tab-size competitors. These aren't intended as departmental printers, but one of those 4550s hanging off your network would be a popular addition, Mr. Network Manager.

It's widely forecast that ink jet printers are going to start squeezing lasers out as we near the turn of the century. Ink jet designs have huge manufacturing economies and have begun to move out of their earlier home printer role as the print quality has improved. I think the availability of high-quality color on ink jets is going to accelerate that move. Color quality on expensive color laser printers from Apple, Canon, Hewlett-Packard, QMS, and others has only been so-so, and while these printers have the ruggedness needed for departmental network use, ho-hum print quality along with relatively high operating costs have kept them from wide adoption. The advent of rugged, fairly high-speed printers for business use, such as the Tek 340 and 350, combined with high image quality and low consumer costs, promises to push ink jets into much wider use in business.

Eventually, we'll probably see a division in office printing between relatively expensive, high-speed, high-quality, black-only laser printers for long-run/high-quantity jobs—today's excellent HP LaserJet 5Si is a precursor of those machines—and less expensive, somewhat slower color ink jet printers for everything else.

It's a color world out there, and we can't hide from that any longer. □

Bad Boys, Part Deux

Twice a year, we conduct comprehensive reviews of PCs and of graphics boards. And twice a year, this column is devoted to shedding light on some of the vendor-inspired anomalies—and the outright shenanigans—that we uncover during our testing.

Graphics board vendors, this time you can breathe easy. You had your turn in the spring. This time, I'm devoting my column to what the PC vendors have been up to. More often than not, it's the smaller vendors, shipping a few thousand systems a month, that are looking for an edge, then go over the edge, and then wind up in the PC Labs doghouse. Here's what the bad boys have been doing, based on evidence from the testing we've done in PC Magazine Labs for this issue's roundup of 51 Pentiums and 40 Pentium Pro systems:

Installing parts nobody would put in a desktop PC. A perennial favorite is the caching hard-disk controller with megabytes of memory on-board. Do you know of any desktop PC user who has—or needs—anything so exotic? Me neither. During testing, one vendor, Micro Express, supplied us with a SCSI controller with 16MB of memory.

Using parts they don't sell. Another vendor, Comtrade, sent us a system with a hot Matrox Millennium graphics adapter—a product the company doesn't sell. We learned about it when we called, posing as customers dying to buy a system with the Matrox card. We removed Comtrade from the review.

Lowballing the price. Some vendors make a wild guess at what their prices might be two or three months down the road and cite those, even though our instructions say the prices quoted must be as of our editorial deadline. Others "forget" that the configured-system price includes the monitor.

Our worst offender this time around was Micro Express, a smaller vendor that makes capable systems. Here's what Micro Express sent us: a Pentium/200 with 512K of external cache, 16MB of EDO RAM, a 2GB Quantum Atlas Fast/Wide SCSI-2 hard disk with a 16MB CMD caching controller, an STB LightSpeed 128 graphics adapter with 2MB MDRAM (multibank DRAM), a Sony 8X CD-ROM drive, a Creative Labs Sound Blaster AWE32 sound card, and a MAG 17-inch monitor. Micro Express said it costs \$2,999, or \$2,495 with an equivalent P200+ Cyrix CPU.

Intrigued by the low, low prices, researchers Josh Levy

and Richard S. Shim called back, posing as customers, and found that well, yes, you *could* approximate those prices—if you dropped back to an Enhanced IDE disk interface (with no on-board cache) and to 256K of external cache. If you really wanted the full-boat configuration, the Micro Express reps said it would be \$3,894 for the Pentium model, and \$3,344 for the Cyrix system. Furthermore, they were puzzled about why anyone would want a caching disk controller.

We called Micro Express as *PC Magazine* once again, and its PR rep, David Kaye, told us the current prices were actually \$3,419 for the Pentium configuration and \$2,899 with Cyrix inside. But he said that by late November—when our reviews would hit the newsstand—the prices would definitely be \$2,999 and \$2,495, respectively. That would amount to a price cut of about 25 percent in less than two months. That's a bit hard to believe. But try it yourself: Give Micro Express a call, at 800-989-9900. Tell them you want to buy the *exact* same system we tested (meaning the configuration above), and that you want to pay \$2,999 for it (or \$2,495 for the Cyrix-based version). If you can get it for that price, you've got a steal.

The little guys aren't the only ones that play these games. Gateway 2000 sent us a system with a 2GB Ultra SCSI hard disk that is not in any of their regularly advertised configurations. (To Gateway's credit, it will sell that hard disk to you if you insist.) And just wait till the issue after this

one, when we review home PCs. Gateway sent us a Pentium Pro home PC (well, we did ask for one high-end and one midrange system). And as you may know from reading our previous issue, HP sent us a Pavilion home PC equipped—inadvertently, claims HP—with a next-generation, 200-MHz Pentium MMX chip. It was supposed to be a regular 200-MHz Pentium PC. The addition of MMX technology boosted the PC's performance results by up to 20 percent. An honest mistake, HP says. We're inclined to believe them.

Please understand, I don't believe PC vendors are crooks. But in a marketplace where it's tough to stand out, sometimes vendors push the envelope a bit too far. Stay tuned. □



COST CUTTING

The vendor told us the system cost \$2,999. We discovered it really costs as much as \$3,894.



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NETWORK EDITION

RAID SYSTEMS

Bulletproof Data

RAID systems offer uninterrupted access to data. But which ones also provide easy installation and management?



By Steve Rigney

You probably have dozens of tools and utilities for monitoring your file servers, network cables, routers, and hubs, but what about your data storage? After all, your network isn't much good if your data is lost or temporarily unavailable because of a hard disk crash. In this roundup, we look at four intelligent RAID (redundant array of independent disks) solutions that not only store your data but also protect against failure and provide important information on the health of your hard disks. We asked four vendors—AIWA America, Clariion, Compaq Computer Corp., and Storage Dimensions—each to provide us with a complete turnkey RAID solution

ILLUSTRATION BY MARK MATCHO

INSIDE



RAID has been moving into the mainstream as more and more organizations bring mission-critical data and applications onto their PC-based

LANs. For 24-hour data access, RAID systems with hot-swappable hard disks, fans, and power supplies are the norm, as is management software for keeping track of failures and disk rebuilds.

RAID COMES TO THE RESCUE when a hard disk fails, using redundancy to rebuild data onto a new disk—in most cases while continuing to service disk requests. For the Network Edition cover story, contributing editor Steve Rigney tested four manageable RAID solutions. He evaluated installation, scalability, fault tolerance, and manageability, and found some powerful new management features that we haven't seen before.

GROUPWARE AND THE INTERNET have merged. If you want standards-based messaging, including e-mail, discussion groups, and company-wide sharing of information, take a look at the new e-mail and newsgroup servers from Netscape. Author Rob Lipschutz put both servers through their paces, and he found definite advantages to sticking with standards. (Page NE19.)

ISDN TERMINAL ADAPTERS are getting cheaper and easier to install. Contributing editor Les Freed tested the 3Com Impact IQ, a terminal adapter that offers standards-based compression for top-notch performance. (Page NE24.)

FINALLY, THE PROS AND CONS of using motherboards with networking built in are discussed by PC Labs, West Coast, director Steve Buehler in Multiple Access. (Page NE28.)

—Leon Erlanger

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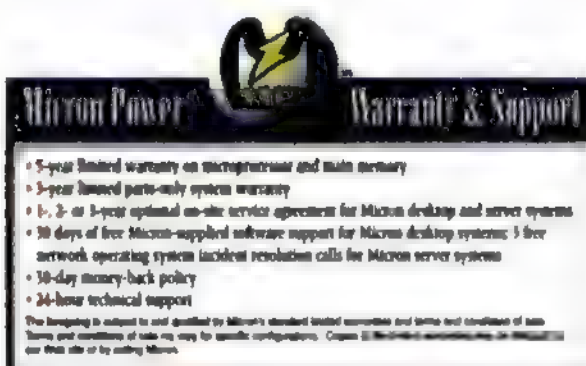
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that included a SCSI RAID controller, cables, chassis, management software, and up to 20GB of storage.

A RAID system consists of either software or a controller and a group of hard disks that work together to provide performance, fault tolerance, or both that is superior to what a single hard disk can provide. Fault tolerance may come from simply mirroring information on two separate hard disks, as in RAID Level 1. Or it may come from storing error-correcting information, known as parity data, on one or more drives—as in RAID Levels 3 and 5—and using it to reconstruct lost data in the event of a disk crash.

RAID LEVELS

There are six principal classifications of RAID systems, defined as RAID Levels 0 through 5 (see diagram). RAID Levels 0, 3, and 5 are by far the most commonly used. With the exception of the Compaq ProLiant, all of the products in this roundup work with RAID Levels 0, 3, and 5. The ProLiant does not work with Level 3.

RAID Level 0 merely stripes data across multiple disks. It offers no redundancy, but it gives you the best performance. Like Level 0, Level 3 stripes data across multiple disks, but it also provides redundancy in the form of a dedicated parity drive. Because RAID Level 3 handles data at the block level rather than the byte level, it is ideal for networks that work with a lot of large files, such as graphical images.

RAID Level 5 is a much more popular solution than RAID Level 3. Like Level 3, Level 5 creates parity information, but it spreads this information across multiple drives rather than a single dedicated drive, and it stripes data at the byte level. Level 5 is thus best suited for networks that perform lots of small I/O transactions at once.

HOST-BASED VS. SCSI-TO-SCSI

Besides RAID levels, RAID products can also be broken down into host-based and SCSI-to-SCSI solutions. In simple terms, a host-based solution puts all of the RAID intelligence on a card in the server, and SCSI-to-SCSI solutions keep it in the RAID chassis, with a plain SCSI controller on the server. The AIWA RAIDstack, Compaq ProLiant Storage System, and Storage Dimensions SuperFlex 3000 with DGR offer host-based solutions, and the Clarion Model 150 Disk Array is based on the SCSI-to-SCSI model.

Host-based RAID solutions are the most common and usually offer the best performance. Since the array controller resides in

Editors' Choice

• AIWA RAIDstack



All of the RAID systems we tested provide adequate

storage and fault tolerance for most NetWare- and Windows NT-based networks.

We especially liked the AIWA RAIDstack, however for its winning combination of scalability, flexibility, and remote management. The host-based RAIDstack has a unique modular design that lets you easily piece together a base unit and a number of

the file server, it can transmit data directly across the PC's bus at theoretical speeds of up to 132 MBps (megabytes per second) using PCI. The actual speed, however, would be somewhere between 20 and 60 MBps, depending on the number and type of SCSI channels on the controller. A SCSI-to-SCSI solution is limited by the available bandwidth of the SCSI channel between the RAID chassis and the PC. In most cases, a SCSI-to-SCSI solution that offers two Wide SCSI channels (40 MBps) has to squeeze that data into a single Wide SCSI (20 MBps) channel back to the host PC.

The biggest drawback to host-based products is that their NOS compatibility is limited to whatever NOS drivers are available. SCSI-to-SCSI solutions are usually not limited to any particular OS, since they just load a standard SCSI driver on the server. Another advantage of SCSI-to-SCSI solutions is that the hard disk subsystem uses only a single SCSI ID. This allows you to connect multiple subsystems to a single controller or use other SCSI devices, such as CD-ROMs and tape backup systems.

FAULT TOLERANCE: THE HARDWARE

A truly fault-tolerant RAID system comes with hot-swappable hard disks, power supplies, and cooling fans. With hot-swappable hard disks, when a disk fails you can swap it out of the system, replace it with a new disk, and rebuild the data on the replacement disk, all while the array continues to handle data requests. All of the systems we looked at offer hot-swappable disks and also support hot-spare disks. A hot-spare disk is lit-

expansion units to achieve up to 104GB of storage. It also gives you the choice of using hardware- or software-based RAID, and single or dual SCSI channels.

Color displays on the base and expansion units clearly show SCSI IDs along with hard disk, power supply, and cooling fan status. AIWA was also the only vendor that bundled a Windows utility for remote management and configuration.

An honorable mention goes to the Storage Dimensions SuperFlex 3000 with DGR. While it doesn't match the flexibility and manageability of the RAIDstack, the SuperFlex was the only RAID system we tested that lets you change RAID configurations and add storage capacity without taking the system off-line.

erally a spare that you place online from the outset. If one disk fails, the array senses the failure, automatically switches to the hot spare, and rebuilds data to that drive.

All of the products provide hot-swappable power supplies, with the exception of the ProLiant, and all offer redundant fans and power. Only the ProLiant and SuperFlex offer a way to make changes to the configuration without taking the server off-line. We were impressed with the ProLiant, which lets you add capacity on the fly without disrupting network access. With the SuperFlex you can add capacity and even change RAID levels on the fly.

PUTTING RAID TO THE TEST

We installed each of the RAID systems under both Windows NT Server 4.0 and NetWare 4.1 and took a close look at the included management software. We also pulled out drives and power supplies to see if each system would stay up and how fast it would notify us of a problem. In all cases when we swapped hard disks, the server stayed up and the new drive was automatically reinitialized and rebuilt. Finally, we gave each product ratings for installation and configuration, scalability, management and notification, and fault tolerance.

There are two steps to installing a RAID system. First, you have to install the controller in your server; then you assemble and connect the chassis. In most cases, we found this to be a simple task. In the case of the Model 150, however, the process was particularly complicated because of the lack of well-written documentation.

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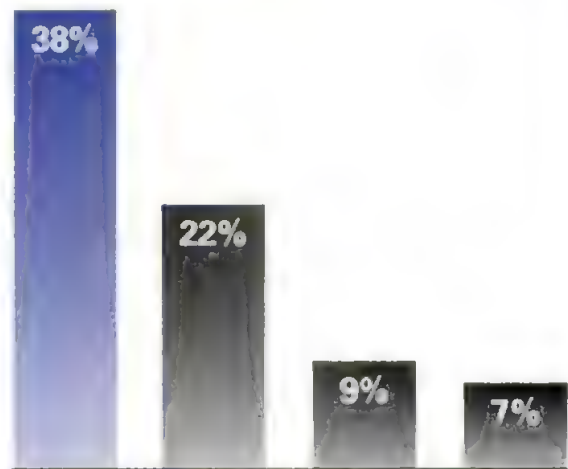
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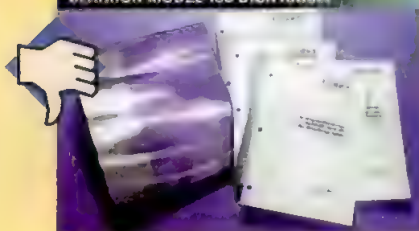
RAID SYSTEMS PICKS AND PANS

AIWA RAIDSTACK



The modularity of the AIWA RAIDstack makes installation and expansion literally a snap.

CLARIION MODEL 150 DISK ARRAY



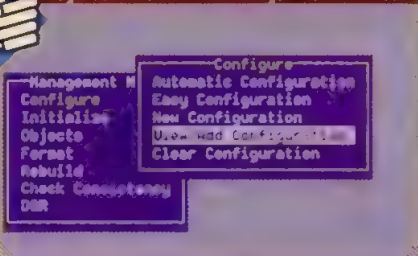
The mounds of documentation, release notes, and driver disks make installing the Clariion Model 150 Disk Array a chore.

COMPAQ PROLIANT STORAGE SYSTEM



The Compaq ProLiant Storage System lacks built-in redundant power supplies and a dual SCSI bus. Both are options, however.

STORAGE DIMENSIONS SUPERFLEX 3000



The Storage Dimensions SuperFlex 3000 with DGR's configuration utility lets you add capacity and change RAID levels on the fly.

The next step is to configure the drives and the RAID level you want to use. Each product provided us with a utility we could run from the server to initialize the drives and change RAID levels. Only the RAIDstack, however, included a graphical application for configuring the subsystem remotely from a network client. The ProLiant includes an easy-to-use graphical setup utility, but the utility doesn't work across the network. The other two products provided only character-based setup utilities.

All the products in this roundup work with multiple NOSs and let you choose among several RAID levels. Since it is a SCSI-to-SCSI solution, the Model 150 is the most scalable, letting you daisy-chain as many as 16 chassis together on a single file server. Of the host-based products, the RAIDstack, which can handle up to 104GB of storage, offers the most scalability. We especially liked the RAIDstack's modular design (see "RAID Systems Picks and Pans"), which makes it easy to add drives and change the SCSI backplane. Compaq's ProLiant only works with Compaq servers, which makes it one of the least flexible solutions in this roundup.

THE REMOTE IDEA

The Clariion and AIWA products came bundled with management utilities; Storage Dimensions and Compaq offer man-

agement utilities as an option. We looked at all four management packages.

We particularly liked AIWA's Array-View, which provides a graphical representation of the RAID subsystem. If a power supply, fan, or drive fails, the management software not only alerts you via network broadcast or e-mail, but it also shows you which component failed and allows you to reinitialize or take the device off-line.

While Compaq and Storage Dimensions don't bundle their management software, they were the only two vendors that offered SNMP management for their RAID subsystems. This allows you to use a third-party product, such as HP Open-View, to manage your subsystems along with all of your other SNMP devices.

AIWA America Inc.

RAIDstack



The host-based RAIDstack, from AIWA America, is the most scalable, flexible, and manageable RAID solution we tested. We like its unique modular, stackable design, which lets it handle up to 104GB of storage on a single server. The package offers both hardware- and software-based RAID and provides a dual-SCSI backplane, remote management, advanced drive diagnostics, and excellent notification features.

The RAIDstack consists of three modular components: the base unit, expansion unit, and SCSI connector module, which AIWA calls a SCSI bus cover. The basic package (\$14,707) includes two redundant, hot-swappable power supplies, one expansion module, and four 4GB hard disks. Each expansion unit (\$554) includes two hot-swappable drive bays. The SCSI bus cover with 4MB of cache comes in single-SCSI-channel and dual-SCSI-channel varieties (the latter costing an additional \$294).

A fully loaded unit like the one we tested (\$25,437) includes the RAID controller with 16MB of cache, a base unit, three expansion units, a dual-SCSI cover, and eight 4GB drives. You can daisy-chain up to three complete RAIDstacks together



RAIDstack.

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Each base and expansion unit includes a color display that shows SCSI IDs and the status of the hard disks, power supplies, and cooling fans. If a component fails, the front display indicates the failure by changing the color of the appropriate icon.

RAIDsoft, a NetWare software-based RAID solution bundled with the RAID-stack, allows you to use any SCSI controller in your server to set up a RAID system. Or you can use the RAID controller, which can handle 8MB to 128MB of cache. It includes two SCSI channels and an Intel 960 processor running at 33 MHz. Installation of the controller would be easier if the documentation included an illustration showing jumper settings. Both setup solutions provide RAID Levels 0, 1, 3, 4, and 5.

AIWA is the only vendor in this roundup that bundles a utility for remote management and configuration. ArrayView is a Windows-based utility that allows you to monitor and control all of your RAIDstack systems. ArrayView shows an exact representation of your stack, complete with the number of expansion units and drives. If a component fails, the graphical representation shows the failure, and the monitoring software—Safe Sentry II—

issues a notification via network broadcast or e-mail.

The ArrayView software communicates with the hardware via the Array Server agent running on the RAID host server. Unfortunately, the software works only with NetWare 3.12 or 4.x, Windows NT Server 3.51 or 4.0, and OS/2 Warp Server 3.0.

The RAIDstack has useful diagnostic features that you can use on all of your disk drives without taking them off-line. **RAIDstack.** List price: Tested configuration, \$25,437. AIWA America Inc., Mahwah, NJ; 800-289-2492, 201-512-3606; fax, 201-512-3704; www.aiwa.com. Circle 953 on reader service card.

Clariion Clariion Model 150 Disk Array

The SCSI-to-SCSI Clariion Model 150 Disk Array has a well-designed chassis with redundant fans, drives, and power supplies. Unfortunately, the product is somewhat difficult to install and provides only mediocre management software.

The unit we tested (\$26,050) came with seven 4.2GB hard disks, a SCSI controller, Windows-based management software, and an internal controller with 8MB of RAM. When we opened the carton, we were greeted with the unwelcome sight of unbound



Clariion Model 150 Disk Array.

manuals, floppy disk packages, and updated release notes for the user guides. It took us a few hours to open all the packages, find the manuals, organize everything in the three-ring binder, and determine which of the software drivers we needed. To make matters worse, the system comes with separate manuals for each software and hardware component but without "read me first" documentation, so it's

easy to miss a step during setup.

You can't use just any SCSI controller in your file server; you have to use the Buslogic SCSI controller provided with the Model 150. The heart of the system is the Storage Control Processor (SP) board in the chassis. The SP includes a 25-MHz AMD 29030 processor and 8MB to 32MB of RAM. It also has a dual-SCSI channel. This allows you to split the device into two SCSI backplanes or daisy-chain up to 16 Model 150s together. The chassis also provides two redundant power supplies, three hot-swappable cooling fans, and seven drive bays.

One of the unique features of the Model 150 is the mirrored write-cache memory card. This credit card-size device can hold up to 2MB of information and includes a small battery backup in case the unit loses power. In a write-

SUITABILITY TO TASK

RAIDstack

Installation and configuration	Good
Scalability	Excellent
Management and notification	Excellent
Fault tolerance	Good

RAID SYSTEMS

How to Read the Suitability to Task Boxes

Installation and configuration We look for RAID packages that come with all the hardware and software needed for installation and don't require changing multiple jumpers or settings on the controllers or chassis. We give high ratings to products that let us easily configure and change settings and RAID levels. An intuitive utility that lets us easily configure all disk drives for the desired RAID level, including any hot-spare disks, earns high marks.

Scalability We look for support for a variety of OSs, for both hardware and management platforms. We note whether the system works with a variety of controllers or whether it requires one in particular. We give high ratings

SUITABILITY TO TASK

Product Name

Installation and configuration	Poor
Scalability	Fair
Management and notification	Good
Fault tolerance	Excellent

to systems that split a single RAID subsystem into two SCSI channels or backplanes and let the user attach multiple controllers (or even servers) to a single unit. We also evaluate the number of drives and connected chassis the system accepts and how much cache memory the controller holds.

Management and notification We look for well-designed management solutions that can be run across the LAN or locally at the server. We look for products that offer both Microsoft Windows- and character-based management software. We give high ratings to systems that let you manage multiple RAID systems from a single location. We also look for notification via network broadcast, e-mail, and paging.

Fault tolerance We look for hot-swappable and redundant disk drives, power supplies, and cooling fans. These should be easy to replace, and the unit should be functional even if one fails. Battery-backed and mirrored cache on the array controller is a plus.



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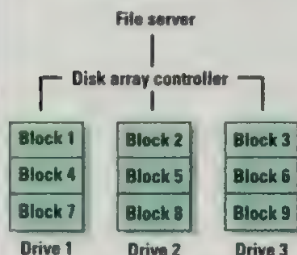
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RAID Levels Compared

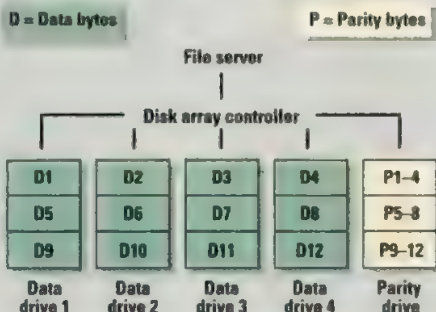
RAID Level 0

RAID 0 uses data striping to break files into blocks and distribute them across the drives. There is no redundancy, but RAID 0 provides very good performance.



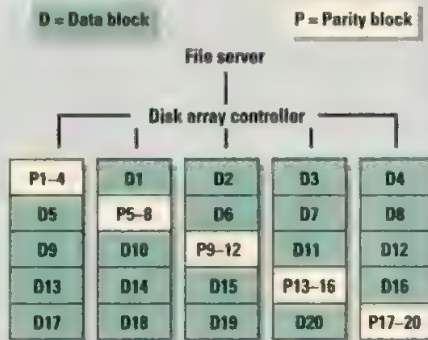
RAID Level 3

RAID 3 uses a single dedicated drive to store parity (error correction) data. The data is striped across the remaining drives, usually at the byte level.



RAID Level 5

RAID 5 distributes parity information across all drives in the array. Data is striped at the block level.



cache environment, the data transfer is considered to be complete as soon as it's written to the memory in the cache. If the power goes down before the cache can write the data to the hard disk, however, the data is lost. With this product, not only does the mirrored write-cache card keep a second copy of the data, its battery backup ensures that the data in the cache will not be lost. You can also move this card from one chassis to another in the event of a failure. The card connects directly to a connector on the SP.

The Model 150 ships with two management and configuration utilities. The DASS (Disk Array Storage System) Manager is a character-based application available as both an NLM and a DOS-based utility. The product allows you to set up your RAID solution, change RAID levels, rebuild or initialize a failed drive, and monitor activity. Unfortunately, the DASS Manager requires you to connect an RS-232 serial cable between your file server and the Model 150.

ArrayGUIDe is a Windows-based utility that allows you to monitor and configure your RAID across the network. With ArrayGUIDe, you can set up alert and error notifications. The software can even send you an e-mail or a page if a drive fails

or a power supply goes down. ArrayGUIDe offers an intuitive interface, but it is complicated to install and runs only over the TCP/IP network protocol. In contrast to Storage Dimension's SuperFlex 3000, you can't use either utility to add capacity or change the RAID level of the subsystems on the fly with the Model 150. If you want to change the RAID settings, you must back up your data and create a new configuration. The optional Prophecy utility (\$7,500) allows you to monitor the performance of all your Clariion disk arrays. **Clariion Model 150 Disk Array.** List price: Tested configuration, \$26,050. Clariion, Southboro, MA; 800-672-7729; 508-480-7280; fax, 508-480-7950; www.clariion.com. Circle 954 on reader service card.

Compaq Computer Corp.

ProLiant Storage System

Unlike the other products in our roundup, the host-based ProLiant Storage System, from Compaq Computer Corp., is not a turnkey solution. The easy-to-install Storage System is a RAID product that you design to your own specifications, using various Compaq components. You choose your own chassis, controllers, and management software. This may be ideal for some setups—especially Compaq-only shops—but the product lacks strong, built-in redundancy and has no management software of its own.

The system we tested (\$10,345) included five 4.3GB hard disks, and the Smart-2 Array controller with 4MB of cache. Unfortunately, Compaq's top-of-the-line Smart-2 controller works only with its ProSignia and

ProLiant servers and requires several installation steps. In addition, you must upgrade your server's BIOS to Version 2.50A or later, run the Compaq server setup utility, and configure your RAID.

The controller provides two Fast/Wide SCSI channels and can handle up to 60GB of storage using two ProLiant Storage Sys-



ProLiant Storage System.

tem chassis. Its most exciting feature is on-line capacity expansion. As with SuperFlex 3000, from Storage Dimensions, you can add more disk drives to your RAID system without downing the server or disconnecting users. But in contrast to the SuperFlex, on this system the new capacity appears as another logical array. This means you will have

SUITABILITY TO TASK

Clariion Model 150 Disk Array

Installation and configuration	Poor
Scalability	Fair
Management and notification	Good
Fault tolerance	Good

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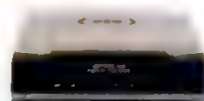


- 8X V.42bis data compression for DTE speeds up to an incredible 230,400 bits/second.
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- Dial-back and password security to safeguard sensitive data.
- InfoWorld Rating: 7.0.
- Costs \$20 less.
- \$20 rebate too.



- 4X compression for speeds up to only 115,200 bits/second.
- Drains precious battery 3 times faster in sleep mode (15mA).
- AutoSync I only.
- Not available.
- Not available.
- InfoWorld Rating: 5.5.
- Costs \$20 more.
- No rebate.

Those aren't the only comparisons. Byte magazine said, "Hayes OPTIMA is the big winner based on data throughput." And InfoWorld wrote, "OPTIMA offers a sturdy design, straightforward installation, and excellent support." If you're looking for these advanced business features in desk-top modems, check out the new Hayes OPTIMA 336 Business modems. And all



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64MB of ECC 4 way interleaved Memory to 1GB	Built-in Expandability with SMP Motorola Chipset	64MB of 60 ns RAM Expandable to 512MB	512K Cache, Intel II Chipset	256K Cache
Slots (6) PCI; (4) ISA	1 Intel Pentium® Pro 200 Processor	ECC Supported	Slots: (4) PCI; (4) ISA	Slots: (4) PCI; (3) ISA
Adaptec 3940 UW	32MB of 60 ns RAM Expandable to 512MB	3 4GB Ultra Wide Removable HD	32MB (60ns) ECC, Expandable to 256MB	64MB (60ns) EDO, Expandable to 512MB, ECC Supported
9 1GB 7200 RPM Ultra Wide Hard Drive	ECC Supported	3 Channel U/W RAID 5 Controller	9 1GB 7200 RPM Ultra SCSI HD	4 1GB Ultra Wide HD
33.3 CD-ROM	Imagine 128 Series II 128 Bit 4 MB VRAM	Open Slots: (3) PCI; (1) ISA	Adaptec 2940 Ultra Wide Controller	Adaptec 2940 Ultra Wide Controller
#9 2MB DRAM Video	Integrated on Board	#9 2MB DRAM Video	Diamond 2MB DRAM	Imagine 128 Series II 128 Bit 4MB VRAM "3D" Video
8GB DAT Drive	• Adaptec 2940 Ultra Wide Controller	10 Bay Tower 300 Watt Redundant Power Supplies	"3D" Video	MS Workstation 4.0
Quad PCI Ethernet 10/100	• Intel 10/100 PCI-Ethernet	Intel 10/100 Ethernet	10/100 PCI Ethernet	Sony Bx CD-ROM
Floppy, Keyboard and Mouse	4 1GB Ultra Wide SCSI HD	Sony Bx CD-ROM	Sony Bx CD-ROM	Keyboard, Floppy, Mouse
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Roll Your Own RAID

By Steve Rigney

The RAID products in the main roundup offer a complete solution for implementing a RAID subsystem, but the least expensive product costs \$10,345 and the rest are priced at over \$18,000. One way to save some money on a RAID solution is to build your own.

Software-only RAID solutions are the least expensive, because they don't require any special hard disk controller or hard disks. Instead, all array operations are controlled by the software running on the host PC. In some cases, you don't even have to have a SCSI controller and hard disks. You can use inexpensive IDE hardware.

Almost every operating system, including NetWare and Microsoft Windows NT, provides RAID Levels 0 and 1. Windows NT Server also provides RAID Level 5. Corel SCSI Network Manager (\$595) provides RAID Levels 4 and 5 for NetWare 3.x. Add a SCSI controller, which costs between \$200 and \$500 depending on cache size, and four 4.3GB hard disks for around \$2,000 each and you have a RAID system for a total of between \$8,200 and \$9,095.

Keep in mind, however, that you get what you pay for. Software-based solutions are slower performers than their hardware-based counterparts, because they use the server's CPU and memory to perform RAID operations. That same CPU has to contend with other applications, such as file and printer sharing. A software-based solution may not only slow down RAID functions but file server operations as well. And unlike hardware-based solutions, most software-based products are OS-dependent.

Another problem with software-based solutions is their lack of acceptable fault tolerance. Fault tolerance is one of the most important reasons people invest in RAID. Some software doesn't work until it is loaded and resident in PC memory. If the disk that contains the array software fails, the array will not initialize, and you will not be able to access your data. Software arrays also commonly require the software to be installed on a separate boot disk that is not part of

the array. And keep in mind that your existing server may not provide the dual power supplies, fans, and other fault-tolerant hardware features that the systems in the main roundup provide.

THE HARDWARE OPTION

Hardware-based array controllers are more expensive but offer more benefits. A hardware-based array controller usually includes a BIOS chip, which contains the RAID software logic, and RAM for disk caching. For example, the popular Mylex DAC960PDU (\$1,350 for one channel; \$1,575 for two channels; \$1,775 for three channels) includes a 33-MHz Intel processor and can hold up to 128MB of cache. This design takes the strain off the host PC and allows all RAID operations and management to be performed on the controller. Most hardware-based solutions provide RAID Levels 0, 1, 3, and 5, and work with all of the major OSs.

The DAC960PDU is a PCI controller that can provide up to 40-Mbps transfer rates and three SCSI channels on a single adapter. Like the Smart-2 Array and SuperFlex products in the main roundup, the DAC960PDU also allows you to add capacity to your array without taking the system off-line. And Mylex bundles Global Array management software, which lets you monitor and control all of your RAID systems from a central location, even across the Internet.

In addition to being faster, hardware-based controllers provide some level of fault tolerance. Because the RAID logic resides on the board, you don't need software to boot the array. Some controllers also offer a battery backup for the write cache, so you will not lose data if the server goes down. In fact, if your server dies, you can move the controller and disk drives to another PC and be up and running within minutes.

Keep in mind that if you don't have room in your server's PC for multiple hard disks, you have to purchase a chassis that includes a SCSI backplane, which will run you around \$2,000, depending on its number of drive bays, redundant power supplies, and other hardware features.

to use your OS utilities (NetWare Install or Windows NT Disk Administrator) to create a new partition and volume before accessing the additional space. The Smart-2 controller provides RAID Levels 0, 1, 4, and 5, but doesn't work with Level 3.

The well-designed ProLiant Storage System chassis doesn't require any configuration beyond inserting the drives and connecting the SCSI and power cables. It provides storage capacity for up to seven hot-swappable 4.3GB disk drives. The standard unit comes with only a single power supply. You can buy an additional redundant power supply (\$1,179), but the fans and supplies are not hot-swappable. The unit provides only a single SCSI backplane unless you buy the Duplex option (\$299), which lets you split the bus into two channels.

You have two options for configuring the

ProLiant Storage System: You can use the Windows-based Array Configuration Utility (ACU) or the character-based configuration NLM. The ACU comes on a bootable CD and can be run directly from the server. It lets you set up your RAID configuration, monitor status, add capacity, and review error logs and reports. You can also view both logical and physical arrays with a click of your mouse. The software even provides you with a Wizard for adding disk space on

the fly. The utility is extremely easy to use, but unfortunately you can't run it across the network from a client PC.

The character-based NLM allows you only to view the status of your RAID system and change settings.

The ProLiant Storage System doesn't include bundled remote management software, so you'll have to purchase an optional package such as Insight Manager from Compaq. Insight will let you view all of your RAID systems across the network, but you can't change the configurations. Insight also offers powerful notification features.

ProLiant Storage System. List price: Tested configuration, \$10,345. Compaq Computer Corp., Houston; 800-345-1518; fax, 713-518-1442; www.compaq.com. Circle 955 on reader service card.

SUITABILITY TO TASK

ProLiant Storage System

Installation and configuration	Good
Scalability	Fair
Management and notification	Fair
Fault tolerance	Fair

Storage Dimensions Inc.

SuperFlex 3000 with DGR

With space for seven hard disks or DAT drives in a single chassis and the ability to change RAID configurations on the fly, the host-based SuperFlex 3000 with DGR, from Storage Dimensions, should meet all of your storage and backup needs. Although the product doesn't currently bundle a graphical management utility, Storage Dimensions does offer a powerful management package that can be purchased separately.

A fully loaded system like the one we tested (\$18,680) comes with seven hot-swappable 4.3GB hard disks, the DGR (Dynamic Growth and Reconfiguration) controller, and 16MB of cache. The unit also includes two redundant power supplies and three fans. You can replace all of these components while the unit is online. Not only is the product extremely easy to install and configure, it comes with all of the drivers and documentation you need to attach it to your Windows NT 3.51/4.0 or NetWare 3.12/4.x file server.

The most powerful component of the SuperFlex 3000 is the DGR controller, which provides dual-SCSI channels so you can attach multiple chassis (up to eight) to a single server. The DGR controller contains a 33-MHz Intel 960 and can handle up to 128MB of cache. Storage Dimensions also offers an optional \$295 battery-backup module for the cache to guard against power loss to your server during a file transfer.

The most exciting feature of the product is its ability to add capacity and change to the RAID settings without taking the system off-line. For example, you can add another drive without restarting the server or disconnecting users. The DGR system will automatically assign the new capacity to your current logical array.

Compaq's ProLiant Storage System also allows you to add capacity on the fly.

**SuperFlex 3000 with DGR****SUMMARY OF FEATURES****Manageable RAID Arrays**

	PC MAGAZINE NETWORK STORAGE EDITORS' CHOICE			
	Aiwa America Inc. RAIDstack	Clarion Model 150 Disk Array	Compaq Computer Corp. ProLiant Storage System	Storage Dimensions Inc. SuperFlex 3000 with DGR
In alphabetical order by company				
List price of tested configuration	\$25,437	\$26,050	\$10,345	\$18,680
Supported RAID levels	0, 1, 2, 3, 4, 5	0, 1, 3, 5	0, 1, 4, 5	0, 1, 3, 5
Supported operating systems:				
NetWare 3.12 and 4.x	■	■	■	■
Windows NT 3.51 and 4.0	■	■	■	■
OS/2 Warp Server 3.0	■	■	■	■
Unix	■	■	■	■
RAID Controller				
RAID controller	■	■	■	■
Cache size	8MB	8MB	4MB	16MB
Supports Fast/Wide SCSI-2	■	■	■	■
Processor	Intel 960	AMD2900	SMD29040	Intel 960
Number of SCSI channels	2	1	2	2
RAID Chassis				
Maximum drive capacity per chassis at RAID 5	30.1GB	25.2GB	25.8GB	25.8GB
Redundant power supplies	■	■	■	■
Hot-swappable power supplies	■	■	■	■
Number of drive bays	8	7	7	7
Supports hot-swapable drives	■	■	■	■
Supports hot-swappable drives	■	■	■	■
Management Software				
Automatically rebuilds failed drives	■	■	■	■
In-band/out-of-band management	■ ■	■ ■	■ ■	■ ■
Notification of failed drives	■	■	■	■

But the new space is set up as another logical array, which is not part of the existing one; this can slow down performance.

The SuperFlex is the only product here that enables you to change a RAID setting without backing up your data, reconfiguring the RAID level, and then restoring the data. In fact, you can change your subsystem from Level 0 to Level 5 while users are still accessing data.

You can configure the SuperFlex using the built-in BIOS utility, DOS-based program, or RAID manager NLM. Unfortunately, Storage Dimensions doesn't provide a graphical utility for configuring the system. Also, there is no way to configure the SuperFlex remotely unless you use a remote-control utility such as Rconsole. Storage Dimensions is working on a graphical remote configuration and management utility that will be bundled in future versions of the product.

If you want to manage the SuperFlex from a remote location, you will currently have to invest in the \$995 VantagePoint application. VantagePoint is a Windows-based utility that allows you to view and

monitor all of your RAID products from a central location. You can view the status of all your devices, but you can't make configuration changes.

In addition to providing basic information about your RAID subsystems, VantagePoint can send a page to the network administrator if there is a problem. VantagePoint also provides SNMP management and a built-in integration kit that will add information to Hewlett-Packard's OpenView SNMP management console. □

SuperFlex 3000 with DGR. List price: Tested configuration, \$18,680. Storage Dimensions Inc., Milpitas, CA; 408-894-1331; fax, 408-944-1200; www.storagedimensions.com. Circle 956 on reader service card.

SUITABILITY TO TASK**SuperFlex 3000 with DGR**

Installation and configuration	Excellent
Scalability	Excellent
Management and notification	Fair
Fault tolerance	Excellent

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

MAIL AND NEWS SERVERS

Netscape Servers Fill the Communications Gap

By Robert P. Lipschutz

If the only tool you have is a hammer, then every problem looks like a nail. But every problem isn't a nail; you may have a screw, a bolt, or a washer thrown into the mix. The same is true with communications problems—they can't all be solved by the ubiquitous Web server, particularly if you're trying to build corporate intranets. Luckily, Netscape has added other tools to your box besides Web servers. Two are in Netscape's intranet product suite, SuiteSpot: Mail Server 2.0 and News Server 2.0. Mail Server allows communication from person to person; News Server allows it among groups.

Both use proven Internet standards to bridge the gap between intranet and Internet communications. Neither product has the breadth of features found in such nonstandards-based messaging products as Lotus Notes or Microsoft Exchange, but you can connect with more people using standards-based products because you aren't limited by proprietary clients.

Mail Server 2.0 complies with both old and new standards, such as Internet Mail Access Protocol (IMAP4), Multipurpose Internet Mail Extensions (MIME), Post Office Protocol (POP3), and Simple Mail Transport Protocol (SMTP).

News Server uses the standard Network News Transfer

Protocol (NNTP) to exchange messages with other news servers. News clients can read and post messages to newsgroups that reside on the news server. But Netscape adds a twist: Sensitive discussions can be fully encrypted using the Secure Sockets Layer (SSL) protocol.

Like the other SuiteSpot products, Mail Server and News Server run on Microsoft Windows NT Server or Workstation, in Versions 3.51 and 4.0.

Server Manager

All configuration is done using HTML forms, frames, and JavaScript.

They also run on several Unix platforms, including SGI Irix and SunSoft Solaris.

As we went to press, Netscape announced Netscape Messaging Server, an upgrade to the Mail Server, and Netscape Collabra Server 3.0, an upgrade to News Server. They will be shipping in the first quarter of 1997.

Netscape Communications Corp.

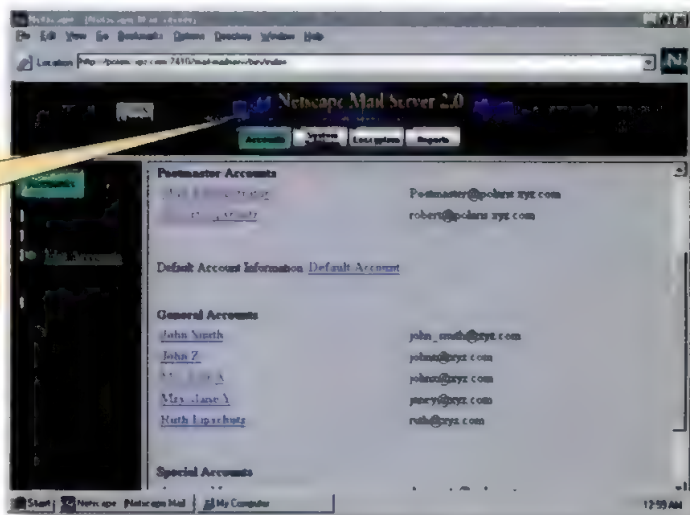
Mail Server 2.0

By giving you the power to communicate with anyone anywhere at any time, e-mail has become one of our most powerful communications tools. Building an effective e-mail

communications system for your business, however, requires not only access to your people but compatibility with the e-mail system of your intended audience. A server that fills these needs may have arrived in Netscape's Mail Server 2.0. This is a straightforward, standards-based e-mail server

variety of Unix platforms. IMAP4 keeps all mail on the server so it doesn't disappear after you download it. It also allows selective downloads; for example, it lets you download messages and exclude attachments. In addition, users can self-manage using HTML or e-mail forms. You no longer need to know about command lines and configuration files.

Mail Server can be used in two primary ways: as an SMTP server or as a primary e-mail server. As an SMTP server, Mail Server lets you access your standard e-mail system indirectly



suitable for either the Internet or the intranet.

Mail Server isn't revolutionary in its design. In fact, in terms of features, it resembles the generic mail servers that have been around for a while, particularly Sendmail, which comes with most Unix operating systems. But Mail Server adds some nice features these old servers don't have, such as a new client-access protocol called IMAP4, flexible management for administrators, and support for Microsoft Windows NT and a wide

variety of Unix platforms. IMAP4 keeps all mail on the server so it doesn't disappear after you download it. It also allows selective downloads; for example, it lets you download messages and exclude attachments. In addition, users can self-manage using HTML or e-mail forms. You no longer need to know about command lines and configuration files.

Mail Server can be used in two primary ways: as an SMTP server or as a primary e-mail server. As an SMTP server, Mail Server lets you access your standard e-mail system indirectly through a gateway. For example, you might use cc:Mail, Lotus Notes, or Microsoft Exchange as your primary corporate e-mail system and use Mail Server as a gateway for your Internet mail. The advantage to this method is that you can keep the user interface and address books of your existing mail system. All you have to do is perform a little maintenance on Mail Server to keep up the SMTP functionality. You can also use Mail Server as your primary e-mail server.

We tested Mail Server as a

NETWORK EDITION

First Looks

primary e-mail server running on Windows NT Server 4.0. The product installs easily from the self-extracting executable file that Netscape designed to facilitate Web distribution. You do need to create a special Windows NT account for the service, however, and make sure it has rights to log on as a service.

Also, before you install Mail Server, find out who handles your company's Domain Name System (DNS). Mail Server works in conjunction with DNS, which contains MX records, to direct e-mail senders to the correct destination mail server.

Managing a server can be difficult, but Mail Server makes it easy. The server is managed through an HTML interface that uses forms, frames, and JavaScript, just like the other SuiteSpot products. This means you can manage Mail Server from the server itself or from any browser-equipped desktop.

Adding e-mail accounts is perhaps the most common task you will face. In Mail Server, this is done through the Server Manager accounts section. For those migrating from a Unix Sendmail system, a bulk import feature is available. An account includes the user's full name, e-mail account—complete with aliases—and finger information so others on the Internet can identify the account.

Aliases can help when you're changing your naming conventions but still want to accept messages destined for the old address. Aliases also work as a

Serving News

News groups can be read-only or you can allow users to post messages.

safety net for users who can't remember your exact address. You might have *jdoh, Doe*, and *JohnD*, for example, all pointing to the same account; Mail Server accounts are case-insensitive.

Mail Server also lets you set up various SMTP parameters. Mail Server can service multiple mail domains from a single

server—*polaris.xyz.com* and *xyz.com*, for example. The mail administrator simply lists these domains in the configuration screen. Another nice administrative feature is deferred delivery, which is useful if you have an intermittent link, such as a modem or ISDN connection.

As the number of users grows, you don't want to be the arbiter of every change. To help you avoid this, Mail Server includes parameters that users can change themselves. These include user passwords, finger information, and vacation auto-reply messages. Users can make these changes through HTML forms or e-mail messages.

Mail Server includes Secure Sockets Layer but only to administer the server. Setting up SSL is a hassle, however, because you must request and install a certificate from a third-party certificate authority.

Secure administration is nice and necessary, but the real challenge is e-mail message encryption. People want to send secure e-mail across an unsecured Internet. Encryption takes place not on the mail server, but on the mail client, so look there for such encryption standards as S-Key and S-MIME. They will appear in Navigator 4.0. S-MIME works similarly to SSL and requires the sender to know the recipient's public key, an elec-

CROSSTALK



Leon Erlanger

“What we found in Netscape's SuiteSpot is a complete set of tools from a company you trust. You can use these tools to build a corporate intranet and have confidence that they'll be upgraded with features you'll want—such as IMAP5 as it moves closer to a standard. SuiteSpot is a comfortable corporate investment.”

“But Leon, it's only comfortable if you buy into having TCP/IP everywhere on your network. Frankly, I think the security risks and overhead of TCP/IP are so high that I'd advise skipping the charms of an intranet until more security options evolve. The proprietary aspects of Notes and Exchange carry their own problems but mostly in hands-on maintenance rather than in security.”



Frank Dorfner

tronic identifier that lets the sender encrypt content so only the recipient can decode it.

Mail Server 2.0. List price: \$995. Netscape Communications Corp., Mountain View, CA; 415-937-3777; www.netscape.com. Circle 951 on reader service card.

Netscape Communications Corp.

News Server 2.0

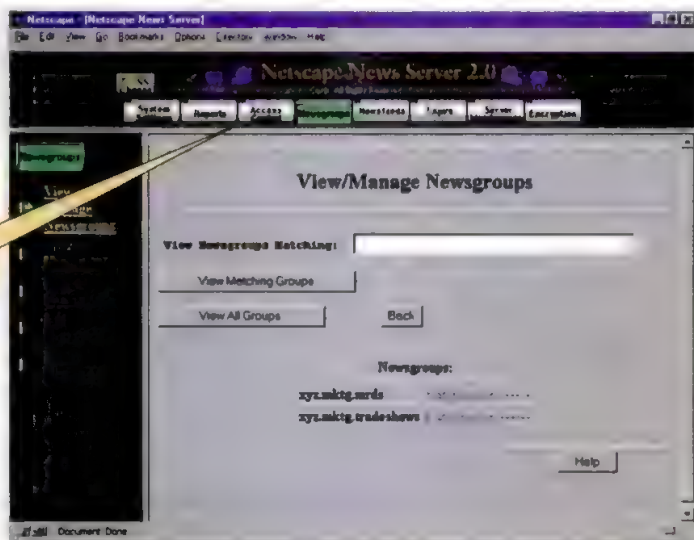
Although Web servers can revolutionize communication both inside and outside a company, it's becoming clear that for interactive discussion groups, products other than Web

servers can handle them better. One such product is Netscape's News Server 2.0, part of Netscape's new server suite, SuiteSpot.

News Server complies with Network News Transfer Protocol (NNTP) and fits the bill for companies needing interactive discussions on intranets and the Internet. The product also functions better than Web servers when it comes to interoperability among clients who you want to participate in discussion groups.

Unlike with such products as Lotus Notes and Microsoft Exchange—which require each person to have a Notes or Exchange client—any client that complies with NNTP can hook into a discussion on News Server. News Server fills the discussion group gap between what you can get from a Web server and what you get with an e-mail system.

Though News Server sticks to established standards, it also has flexible browser-based management, multilevel security, and broad platform support. All of this sets it apart from other NNTP news servers,



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NETWORK EDITION

First Looks

such as those that come with Unix operating systems.

Before you install News Server, however, it's wise to think through the deployment. Having a separate News Server for each location makes sense, because accessing a News Server over a slow WAN link can be time-consuming. You also need to figure out how to get Usenet news feeds from the Internet: your Internet Service provider can usually supply the news feeds.

News Server is available on Microsoft Windows NT and several Unix platforms, including SGI Irix and SunSoft Solaris. We tested it on Windows NT and used the Navigator 3.0 for our client software. But News Server can be accessed by any NNTP news reader running on any OS. The user inter-

News Server fills the discussion group gap between what you can get from a Web server and what you get with an e-mail system.

face for message reading, message posting, and newsgroup display are all specified by the client program.

On our tests, we found News Server newsgroups to be better than e-mail systems for large group discussions, because mailing lists that go out to 20 people or more can be a network resource hog and a nuisance for users whose e-mail inboxes are already cluttered.

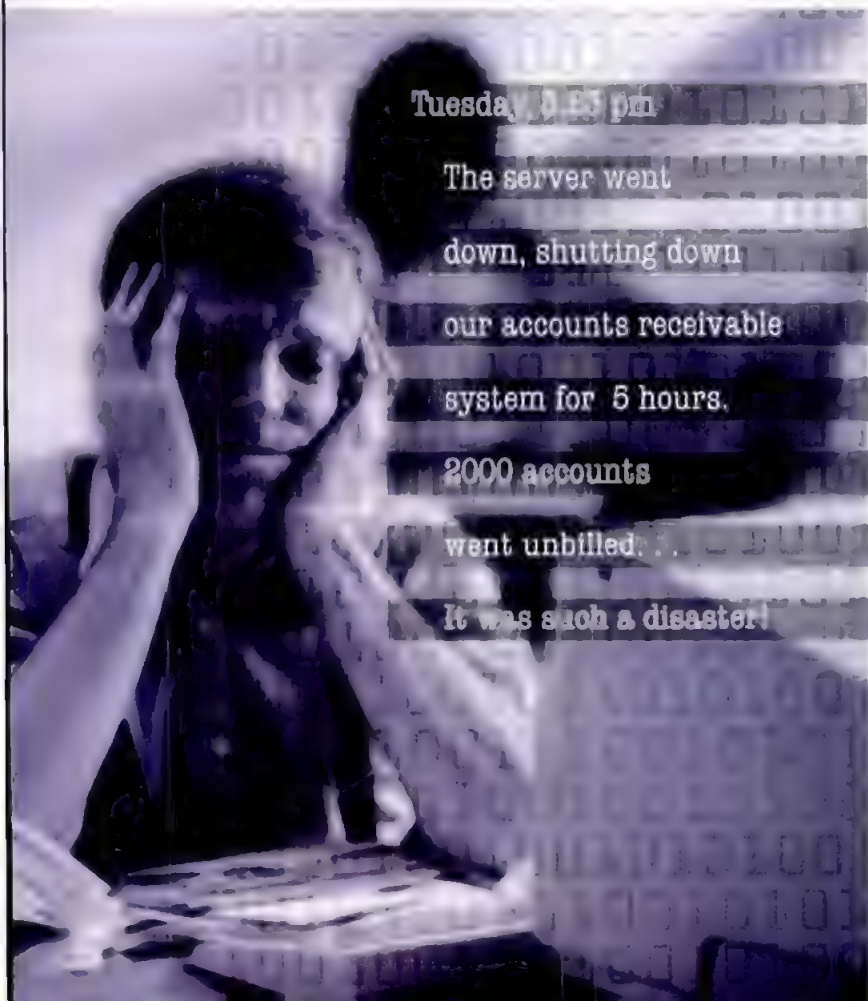
With News Server, users can

read and post messages when they want to. Determining the best method to alert users to a News Server discussion is, however, a challenge. Ironically, the easiest solution may be an e-mail message. But again, the advantage to a News Server discussion is that people who are not on your internal e-mail system can access the discussion.

News Server ably handles both Usenet newsgroups and your own internal newsgroup

creations. In keeping with the NNTP standard, newsgroups and the articles contained in them can be transferred to and from other news servers. News clients, such as the one in the Netscape Navigator client, can read and post messages to these newsgroups, thereby creating an organized multiuser communications platform.

Like the other products in SuiteSpot, News Server is managed via Server Manager, a browser-based interface that uses frames, forms, and JavaScript. Administrators can manage News Server and other SuiteSpot servers from any browser on the network, but the user interface can be clumsy for some operations. For example, each user must be added to access control individually. It would be nice to have



Tuesday, 3:23 pm
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First Looks

some better tools or templates for batch operations.

From Server Manager, the administrator can handle such basic chores as creating and moderating newsgroups, and controlling who can post messages to the groups. The administrator also handles back-end chores, such as optimizing and troubleshooting the discussion group databases and configuring the news server to get news feeds from other accessible news servers. Each function uses HTML forms and JavaScript to validate configuration entries.

Security is, of course, a concern, but News Server lets you add multiple layers of security by limiting access to discussion threads based on the news client's domain name or TCP/IP address. This keeps out the casual user. For more powerful security, you can grant access to users or groups of users that you configure. Before accessing newsgroups, users will be prompted for a user name and password.

Finally, for maximum security, you can use Secure Sockets Layer (SSL) in conjunction with user-name authentication for encrypted news reader sessions. Both the passwords and the newsgroup content are encrypted across the network so no eavesdropping is possible. You need a certificate from a third-party certificate authority, such as VeriSign, to implement SSL.

Netscape's next generation News Server, Collabra Server, was announced as we went to press. It will include more features to compete against Lotus Notes and Microsoft Exchange. Along with this new product, Netscape is also helping formulate a new NNTP standard that will encompass capabilities such as users' ability to create discussion groups.

News Server 2.0. List price: \$995. Netscape Communications Corp., Mountain View, CA; 415-937-3777; www.netscape.com. Circle 951 on reader service card.

ISDN TERMINAL ADAPTERS

3Com Makes an ISDN Impact

By Les Freed

The market for ISDN terminal adapters (TAs) has exploded in the past year, a fact that hasn't gone unnoticed at 3Com. The company's original Impact ISDN TA was just so-so, but their new Impact IQ ISDN TA (\$499 list, \$350 street) raises the price/performance bar several notches. It's also the easiest to in-

stall. The Impact IQ is the first external TA we've seen to include Stac compression. In informal testing, it outperformed our Editors' Choice, Motorola's Bit-Surfr Pro, by up to 100% on plain-text file FTP transfers. The end result is two-B-channel performance on a single B-channel.

But all that speed creates another problem. Stac compression running on two-B-channel 128-Kbps ISDN links can provide throughput peaks of up to 256 Kbps, which is more than twice the speed a standard serial port can handle. The Impact IQ supports serial-port

clever configuration program asks you for the phone number, and a wizard—the SPID Wizard—figures out the rest.

We ran the SPID Wizard through its paces twice. First, we connected an unconfigured Impact IQ to an ISDN line and ran the configuration program. After a few seconds, the SPID Wizard asked for the phone number for the first B-channel. We entered the number, and a few seconds later the Wizard asked for the second phone number. After a few more seconds, the Impact IQ was fully configured and ready to place and receive calls. We then disconnected the first line and plugged the Impact IQ into a different line and ran the configuration program again. The SPID Wizard recognized the change and asked us to enter numbers for the new phone line.

Unlike its predecessor, the Impact IQ supports Data Over Switched Circuit Voice (DOCSV) calls. 3Com calls this feature TollMizer, and it can significantly reduce your ISDN line charges. In many areas of the country, the local phone company charges by the minute for ISDN data calls but not for

voice calls. DOCV, as its name implies, takes advantage of this rate loophole by turning on a special tone that tells the phone company it's placing a data call when it's actually placing a voice call. The downside to DOCV is that data calls placed this way are limited to 56 Kbps instead of the normal 64 Kbps. The service you are calling must support inbound DOCV calls; and many routers do, particularly the Ascend routers used by many ISPs. We were able to connect to our Ascend Max 1800 and Max 400 test routers in both DOCV and conventional ISDN modes.

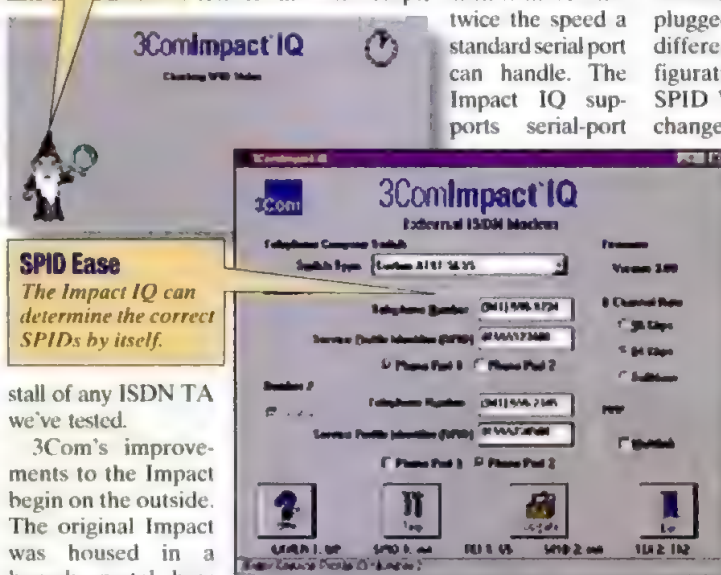
ISDN TAs can be difficult to install. The ISDN adapter must be carefully configured to cooperate with your local telephone company switch. In North America, each ISDN adapter must be programmed with one or two service profile identification (SPID) codes. A SPID is a 10- to 14-digit number that identifies the TA to the phone company. The Impact IQ is the first ISDN TA we've seen that can determine the correct SPIDs by itself. A

ISDN Wizard

The wizard guides you through configuration.

SPID Ease

The Impact IQ can determine the correct SPIDs by itself.



stall of any ISDN TA we've tested.

3Com's improvements to the Impact begin on the outside. The original Impact was housed in a homely metal box; the new unit comes in a swooping, stylish white plastic case about the size of a VHS tape. Unfortunately, the curved top of the Impact IQ prevents you from placing a phone on top of the unit, a feature we liked in the old Impact. The Status LEDs are also improved; 8 LEDs show power, ISDN line, and RS-232 status at a glance.

Most ISDN TAs are used to connect to Internet service providers or to corporate LANs. In either case, the device answering the call is usually a router or remote-access server. Many routers can perform Stac LZS data compression, which can provide up to a 2:1 throughput

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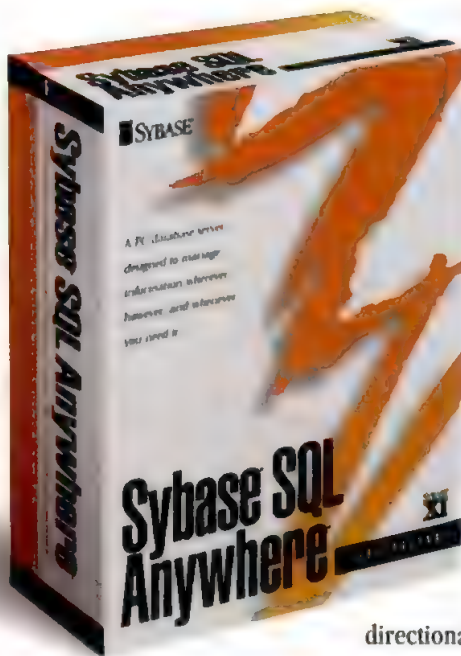
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After disconnecting from e-mail, your Web browser allows you to view the fully-updated intranet. Locally. Offline. From wherever you are and wherever your business transactions need to occur.

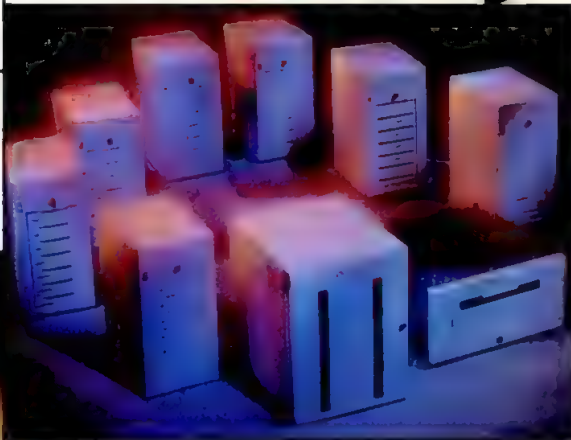
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First Looks

The Impact IQ includes two POTS jacks, and you can program either one to connect to either of the two ISDN B-channels. Unlike many TAs, the Impact IQ supports multiple telephones on each POTS jack and provides normal ring voltage to the POTS jack on incoming

calls. Audio quality on the POTS jack was excellent.

The Impact IQ includes installation disks for PCs and Macintosh. The PC disk includes drivers for Windows 3.x, Windows 95, and Windows NT. 3Com includes an ISDN line cord and a 9- to 25-

pin serial cable for connection to a PC. A fax-back coupon is provided for a free Macintosh serial cable, but you have to pay \$8 for shipping. An included CD-ROM contains copies of Macromedia's Backstage Designer, Qualcomm's Eudora Lite, and Microsoft

Internet Explorer 3.0. The CD also has sign-up kits from several ISDN-capable Internet access providers.

Impact IQ. List price: \$499. 3Com Corp., Santa Clara, CA; 408-764-5000; fax, 408-764-5001; www.3com.com. Circle 958 on reader service card.

NETWORK ANALYSIS TOOLS

Finding the Problem Is No Fluke

By Steve Rigney

Though it looks like a game or a fancy PDA—it's hand-held, has a great touch screen, and is fun and easy to use—the Fluke One-Touch Network Assistant is nothing if not a serious networking tool. This product is designed to help those who are on the front line troubleshooting network problems, such as bad cables, network packet errors and collisions, redundant IP addresses, and faulty network adapters on both 10-Mbps and 100-Mbps Ethernet LANs. With a retail price of \$3,695 for the 10-Mbps solution and \$4,995 for the combination 10/100-Mbps unit, this product isn't for everyone. Network consultants and administrators of large networks, however, may wonder how they ever lived without it.

The first thing we noticed about the Network Assistant was the large backlit display with touch-screen icons. Unlike similar products, including the Microtest Compas and the Scope Communications Frame Scope, the Network Assistant doesn't provide any buttons. You can perform all of the tasks just by touching the appropriate icon. The Network Assistant's display is also bigger than its competitors'. In addition, the unit provides four simple LEDs that change color to provide basic information on your network link, utilization, collisions, and errors.

The main screen provides icons for five network troubleshooting tasks: an auto-test, your network health, cable tests,

NIC/hub test, and a TCP/IP ping. The display also has an icon for printing the current display, switching between 10- and 100-Mbps Ethernet, setting up and testing the unit, and online help. All of these tasks are easy to perform.

The auto-test provides the most information about your network. When you select this icon, the Network Assistant automatically determines the length of the network cable between you and the hub, finds the names of your NetWare and NetBIOS servers, looks for any IP routers, and counts and identifies all of the local stations on the network. This version of the product doesn't specifically identify your Microsoft Windows NT servers by name, but it does show you the names of the Windows NT Domain, Primary Domain Controller, and Master Browsers. In fact, the Network Assistant can identify by name any PC running the NetBIOS protocol, including Windows for Workgroups, Windows 95, and Windows NT.

The only problem we encountered with the auto-test was that the number of local stations on our network kept decreasing. Fluke is aware of this problem and plans to fix it in a future release. It seems that if a PC is run-

ning two Ethernet frame types, such as Ethernet 802.3 and 802.2, the Network Assistant counts the first frame type and when it sees a different frame type from that same PC, it thinks the station is no longer local. When the original frame type appears again, however, the station is added to the list. The total number of stations the Network Administrator can show is 250.



Troubleshooting: Just touch the on-screen icon and the OneTouch performs the task.

The network health icon presents you with a series of gauges that show you the percentage of network utilization, errors, collisions, broadcasts, protocol usage, and stations. If you touch one of the gauges, you can see which station is the top sender. For example, if you touch the network broadcast icon, you see the PC that is sending the most broadcasts. The network protocol icon even

shows you the percentage of the different protocols in use on your LAN including AppleTalk, IPX, TCP/IP, and NetBIOS.

The cable tests include an auto-test, wiremap, and toner, as well as an option for defining Category 5 cables. The auto-test determines the length of the UTP cable you're connected to and makes sure there are no errors. The Network Assistant is also the first product that can test 100Base-TX connections. The folks at Fluke are considering adding 100Base4, but they do

not plan to work with 100VG-AnyLAN. The Network Assistant can't test coaxial cable.

The wiremap test shows you the exact pin-out of your cable and if any wires are crossed. The toner utility requires a separate toner probe, but it's a nice feature. The toner test sends a sound across the cable allowing you to probe for breaks or shorts in the cable.

The NIC/Hub tests are useful if you think your network adapter is bad or if you need to find an unused port on the hub. The NIC test makes sure your adapter can send and receive network packets and frames. The hub test can determine if a hub has any ports that are not connected to a network device. This is much more useful than just looking at the link lights on the hub. If a station is not turned on, the hub does not provide a link light, but the Network Assistant does.

The last test, the IP Ping, is great for determining if TCP/IP is installed properly on your LAN or if there are two PCs with the same IP address.

The Network Administrator doesn't provide the ability to certify cable, as does the Microtest PentaScanner, nor can it analyze network protocols, like the Frame Scope, but it is still a powerful tool for front-line troubleshooting. It would take a small book to explain all the features of this product. Our advice for network administrators and consultants is to give this product serious consideration.

OneTouch Network Assistant. List price: Tested configuration, \$4,995. Fluke Corp., Everett, WA; 206-347-6100; fax, 206-356-5116. Circle 952 on reader service card.

NETWORK UTILITIES

Alexander's NetWare Air Bag

By Steve Rigney

Many a NetWare utility can back up and restore your data, load and unload NLMs, scan for viruses, monitor usage and statistics, and even tune your server's performance. But Alexander's Server Protection Kit is the only one we know of that is solely designed to deal with server crashes. SPK retails for \$698 per server and provides three NLMs that can prevent your server from crashing, explain what happened during a crash, and attempt to bring the server back up after a crash.

The product consists of Microsoft Windows-based Emergency Diagnostics for the Network Administrator, or Edna, a

utility for monitoring information; and three NLMs—NetCheck, SPK Debugger extender (Dexter), and Edna, which is separate from the Windows-based Edna utility—that run on your NetWare 3.x or later file server. We found the product very easy to install. There is a bug, however, that puts a drive letter in place of the volume name in your server's AUTOEXEC.NCF file and loads the NLMs in the wrong order. Alexander includes a README file that shows how to correct this problem.

The NetCheck NLM is probably the most important. It's designed to prevent ill-behaved NLMs from corrupting your

server's memory and causing a crash. It also includes options for checking reads and writes as well as saving events to a log file on your server's hard disk.

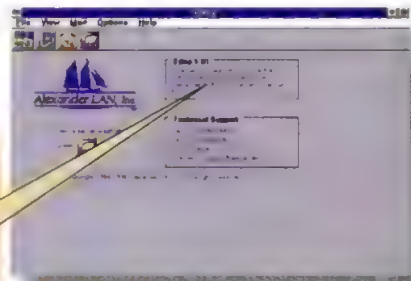
If your server does crash, Dexter can help you determine why. Dexter allows you to walk through the OS stack after a crash and ex-

tempts to restart the OS. Edna can even create a Novell Core Dump image that you can send to Novell for troubleshooting.

Another of Edna's features is its ability to launch NetWare's

SPK's Edna

Edna lets you view server crash information and reports, and create e-mail.



plore the NOS. It shows you the calls and events that led up to the crash, plus which tasks were being performed at the time. But Dexter requires a strong knowledge of the NetWare OS.

The Edna NLM automatically takes over the server after a crash, runs diagnostics, and at-

tempts to restart the OS. Edna can even create a Novell Core Dump image that you can send to Novell for troubleshooting.

Volume Repair utility automatically after a crash. NetWare 4.x can also perform this task. **Server Protection Kit.** List price: \$698 per server. Alexander LAN Inc., Nashua, NH; 603-880-8800; fax, 603-880-8881; www.alexander.com. Circle 957 on reader service card.

MULTIPLE ACCESS By Steve Buehler

Network Ready or Not...



If you're responsible for purchasing desktop machines for your company, you may want to start letting the PC manufacturer install your networking right on the motherboard. Many PC companies (Compaq, HP, and IBM among others) are now providing complete solutions for network-enabled PCs, a trend that may make sense for your business.

If you purchase your computing equipment from a VAR, chances are you've purchased PCs that already had networking set up. If, however, you have a staff of administrators and support techs who set up your machines, you may find that the costs of adding in network cards—\$50 to \$100 each—outweighs the perceived flexibility many network administrators cite as a reason for not using built-in networking. Most admins like to pick the NICs they install and set up, and being able to upgrade or change the NIC or the underlying networking (moving to 100-Mbps Fast Ethernet, for example) is valuable. Though the cost of add-in NICs is usually more than that of built-ins, the real motivation seems to be that admins have standardized on one or two cards they like. The Intels and 3Coms of the world have good products, and these companies have a track record of updating drivers for OS support, performance, and reliability that PC vendors may not.



The latest round of PCs with on-board networking, however, are attractive for another reason. Big name manufacturers, such as Compaq, HP, and IBM, have all added value to their business PCs through desktop management-enabled features that can save time and effort in certain environments.

For example, HP and IBM both support extensions to the Desktop Management Interface specification that allow network managers and administrators to power down machines at specified times, power them up at other times, and even reboot the machines to known states. The security benefits are obvious; the interesting use is for training rooms or labs. At PC Magazine's West Coast Labs, I often have to shut down and restart machines to rerun tests. Setting those machines back to standard configurations can be time consuming, but with the capability HP and IBM offer, I could reset whole testbeds with a few clicks of a management console's mouse.

Another application for this technology is in shared machines. If you've decided not to allow Internet access to everyone in your company, you may have several machines in a common area with browsers for occasional surfing. Resetting these machines to known states will clean up cache files, remove any leftovers your users may have forgotten about, and ensure that any creative users haven't made changes you have to spend hours diagnosing and correcting.

Building in the NIC isn't a new idea, but these vendors have taken the smart step of adding value through these management tools. We'll see more of these setups in the future. Will you be ready to take advantage of them?

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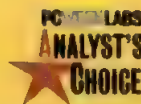
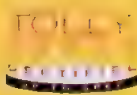


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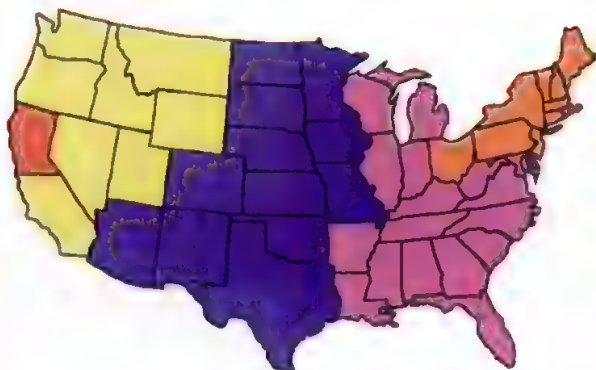
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CHOOSE YOUR 200

PC Labs tests 40 200-MHz Pentium Pro PCs running Windows NT 4.0, and 51 Pentium/200 and Cyrix 6x86-P200+ PCs equipped with Windows 95.

By Carol Venezia

They may all be stamped with a "200," but don't let the numerical similarity fool you: The Pentium Pro, the Pentium, and the Cyrix 6x86 are completely different processing beasts. But whether you're talking about the powerhouse optimized for 32-bit performance, the mainstream speed demon, or the up-and-coming mainstream contender, the bottom line remains the same for this CPU triad: They all represent the pinnacles of power in the x86 world.

Why all 200s, you ask? For this story, traditionally our annual roundup of virtually all PCs on the planet, we decided to take a different road from the one previously traveled. We wanted to look at the best and fastest that the market had to offer—mated to the appropriate operating system—because we've always been big proponents of the notion that buying behind the speed curve doesn't make much sense if you want your PC to last. And given the average prices of the machines here—\$3,700 for the Pentium Pros and \$2,800 for the Cyrixes and Pentiums—power has never been more affordable.

THE MAINSTREAM: PENTIUM, CYRIX, AND WINDOWS 95

The systems that we review in this roundup are without a doubt aimed at distinctly different audiences. Call it marketing clout if you will, but the marriage of the Pentium Pro with



PENTIUM/CYRIX AND WINDOWS 95 For the single user or the small office, where affordability and flexibility are essential for a new PC, today's 200-MHz Pentium and Cyrix 6x86-P200+ machines running Windows 95 have a lot to offer. Many configurations are available for less than \$3,000, and most offer great multimedia support, including 8X CD-ROM drives and wavetable audio subsystems.

Windows NT 4.0 and the Pentium and Cyrix with Windows 95 was no accident. It also makes perfect sense from a performance and features standpoint.

For the first part of this roundup, we look at the Pentium, Cyrix, and Windows 95 trio. Either of these processors, joined with Windows 95, represents the perfect combination for the mainstream user, be it the small-business owner or the home user tracking finances and surfing the Internet. Why? Because today's Windows 95-based PC supplies the necessary ingredients for this type of audience: ease of use and affordability.

When Windows 95 was introduced a year ago amid much fanfare and strains of "Start Me Up," there was no question that it was targeted at the mainstream user, particularly the consumer. The strong influence of the Internet and new multimedia-oriented applications combined to produce a new platform that was actually fun (read: not just for nerds anymore), not to mention beneficial. With DirectX APIs including DirectDraw, DirectSound, and DirectPlay, video never looked so good, and audio never sounded better. All this friendly new OS needed was a powerful processor to push through all the bits, bytes, and video streams. Enter Pentium and Cyrix.

The Pentium processor has literally grown by leaps and bounds in the past 12 months in terms of speed. When we conducted our big fall roundup last year, the high end was defined as either a 120- or 133-MHz Pentium. Now the high end is 200 MHz (although the design made pit stops along the way at 150- and 166-MHz). And this processor is well-suited to the split-code personality of Windows 95: Unlike the Pentium Pro, which has been optimized for strictly 32-bit code, the Pentium can adeptly handle 16-bit code as well, much of which is still found in Windows 95.

But how far, you ask, can the Pentium go? Even though its clock has been pushed to 200 MHz, the performance gain you'll see in typical applications usage is minimal—just 5 percent more than the Pentium/166. As we reported online recently ("Pentium/200 Hampered by Memory, I/O Bottlenecks," PC Labs Online, July 11) the Pentium/200's performance is limited by bus bandwidth: specifically, a 66-MHz system bus and a 33-MHz PCI bus. Indeed, while the Pentium/200 runs at three times the speed of the original Pentium, bus speed remains stuck at 66 MHz. And although this CPU will receive a shot in the performance arm when the P55C with MMX is introduced in the first quarter of 1997, bus speeds will be the same. But while Intel's bus continues to travel at a steady 66-MHz, another vendor has appeared in the left lane going 75: Cyrix.

Although the Cyrix 6x86 P200+ processor runs at only 150 MHz internally, by pushing the system bus speed to 75 MHz and fully exploiting the chip's efficient microarchitecture, this CPU performs on a par with a 200-MHz Pentium. This bus speed improves overall system bandwidth by 14 percent and eases the bottlenecks that plague the Pentium/200. On the downside, the PCI bus still remains at 33 MHz, because



PENTIUM PRO AND WINDOWS NT If you're a corporate buyer seeking a manageable, powerful, and affordable combination of hardware and OS, there's no better choice today than a PC equipped with a 200-MHz Pentium Pro processor and Microsoft Windows NT 4.0. Pricing is more attractive than ever before, with many fully equipped PCs selling for less than \$4,000

the processor must interface with it asynchronously (as opposed to the Pentium architecture's synchronous operation with the PCI bus), which in reality may induce wait states. The faster bus also requires more expensive cache SRAMs.

PRO • 4.0 • CORPORATE DESKTOP

The Pentium Pro and Windows NT 4.0 duo are aimed squarely at corporate buyers, both by system vendors and by Intel and Microsoft. Indeed, they do represent a great buy for the corporate set because together, they directly address long-term cost-of-ownership concerns that plague IS managers and budgeteers alike. Combine Windows NT 4.0's extensive security features and nearly crash-proof design with its friendly new Windows 95-like interface, and you have an operating system likely to please both the person behind the desk and the person that's charged with maintaining that desktop.

Intel has also done its part with the Pentium Pro and its surrounding components to address cost-of-ownership concerns. The CPU, as has been widely publicized since its introduction a year ago, is optimized for a full 32-bit environment, which means both the OS (Windows NT 4.0) and the applications that run on the PC. This provides a measure of insurance against obsolescence because most ISVs are developing 32-bit versions of their applications.

The Pentium Pro's core-logic chip set also does its part in this lower-cost scenario: The 440FX PCIs set, unlike its predecessor, supports error-correction-code (ECC) memory to ensure data integrity, Universal Serial Bus to support up-and-coming peripherals (although there are still no NT drivers for USB), as well as concurrent PCI for more efficient handling of video and audio, among other features. This chip set is also inherently cheaper for vendors to purchase and deploy than Intel's previ-

ous Pentium Pro chip set. The actual number of chips has dropped from seven to three, the chip set can be used on a four-layer motherboard, and performance is better.

The Pentium Pro CPU itself is also dropping in price. Intel's third-quarter pricing puts the 200-MHz/256K cache Pro at only \$53 more per part in quantity than the 200-MHz Pentium (\$562 versus \$509). Although Intel had not announced fourth-quarter pricing before we went to press with this story, the vendor had announced that while Pentium Pro CPUs would enjoy another price reduction in the quarter, Pentium prices would remain the same.

If you look at specific features of the 40 Pentium Pro systems in this story, you'll see that system vendors are hip to the corporate voice as well. Features such as DMI compliance, preloaded management information file (MIF) browsers, integrated Ethernet adapters (as well as add-in PCI-based Fast Ethernet adapters), and easy-to-service designs are slowly making their way onto the corporate desktop. But while the latter of these four features is prevalent, DMI-compliant PCs with MIF browsers have been slower to catch on. You'll find a MIF in systems from major vendors—including AST, Dell, and IBM—but not in systems from smaller vendors, mainly because of the extensive development costs involved. Looking forward, we fully expect this feature to become a check-off item for corporations looking to buy new PCs.

THE BOTTOM LINE

In the following pages, you'll find reviews of 91 systems—from corporate-oriented Pentium Pro PCs with Windows NT 4.0 to Pentium- and Cyrix-based mainstream machines with Windows 95. Whether you're buying for the glass house or your own house, we're confident that you'll find a system suited not only to your needs but to your budget as well.

Vendor Service and Reliability

We include ratings for vendors that received at least 50 responses to our latest Service and Reliability poll of 17,000 subscribers. These results reflect readers' experience with desktop PCs from a given vendor. We analyzed data using a t-test, a standard procedure for identifying differences from the average that are significant at the 95 percent confidence level. For details, see our July 1996 issue.

The **reliability** rating is a measure of respondents' satisfaction with the reliability of a vendor's desktops in use over the past two years.

The **repair** rating is a measure of respondents' satisfaction with the repair service provided by a vendor for PCs in use over the past two years.

The **technical support** rating is a measure of respondents' satisfaction

with a vendor's support for machines in use over the past two years.

The **percent needing repair** rating is a measure of the proportion of PCs that

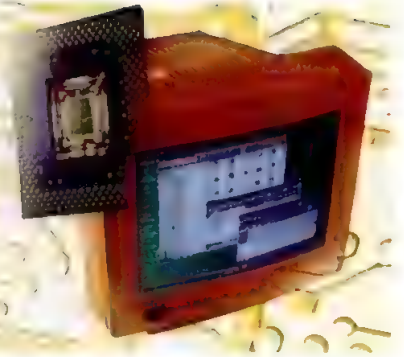
respondents said needed repair in the past year. Better than average means that the incidence of needed repairs is significantly lower than average.

	SATISFACTION WITH				Units needing repair
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○ Significantly better than average ○ Average ● Significantly worse than average					
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ALR	○	○	●	○	
AST	○	○	○	○	
Austin	○	○	○	○	
Dell	○	○	○	○	
DTK	○	○	○	○	
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IBM	○	○	○	○	
Micron	○	○	○	○	
MidWest Micro	○	○	○	○	●
NEC	○	○	○	○	
Unisys	●	○	○	○	

MAINSTREAM CHOICES

Whether you opt for an Intel or a Cyrix CPU inside your new PC, it has ample power to handle today's business apps. PC Labs tests 51 200-MHz—class PCs.

BY ROBERT S. ANTHONY



We live in a world of choices. You'd think that in such circumstances, you could have your pick of processors from numerous vendors when shopping for a new high-speed Windows 95 PC. Recent history proves that false, however: Intel has been the only power game in town. Intel did have competition in the Windows world from both Cyrix and AMD, but those vendors have traditionally been relegated to the ranks of low-speed bargain alternatives.

Such, however, is the case no more. Cyrix has stepped up to the plate with its 6x86 processor to give the Pentium a run for its money. At the high end—the 6x86-P200+—this CPU soundly challenges the 200-MHz Pentium with mainstream business applications. In fact, of the 51 PCs in this roundup, the Winstone champion is packing a Cyrix CPU.

But no matter which CPU they use, there's no doubt that these machines have a lot to offer. Performance is better than ever before, thanks to components such as high-speed graphics accelerators and Fast/Wide SCSI hard disks, not to mention the drivers that these components interface with, which are now mature and tuned for top-notch performance. And with exciting new peripherals like 12X CD-ROM drives and CD-R devices, your new PC options are limitless.

WHITHER THE VENDORS?

As of the beginning of October, Cyrix had signed up only one major vendor—Acer—to sell systems with its 6x86 chip. In fact, shortly after the introduction of the 6x86, Cyrix teamed up with

Electronic Data Systems to manufacture and sell its own Cyrix-labeled PCs to jump-start sales and promote the Cyrix name. Cyrix's line is still with us, but so far, efforts to spread the chip through the industry have met with little success.

We've posed the question "Why not Cyrix?" to vendors, and responses have fallen into three basic categories: "Intel Inside" is a proven, salable commodity; we don't want to incur the wrath of Intel; or we don't want to compete with our CPU supplier (namely Cyrix) for PC sales. Whatever the reason for the 6x86's lack of popularity, the upshot is that Intel still dominates the market by an incredibly wide margin.

NEW BENCHMARK TESTS

As is our annual tradition, this story marks the introduction of our new benchmark tests. Our flagship test program, ZD Winstone, is still alive and well, and it is now segmented into two separate 32-bit test programs: Business Winstone 97 and High-End Winstone 97. For this Pentium-class Windows 95 section, we focus on Business Winstone. (For an in-depth discussion of the new benchmark tests, see this issue's PC Tech section.)

The results of our Business Winstone 97 tests prove that when it comes to business-oriented Windows 95 applications, the Cyrix 6x86-P200+ is more than able to compete with the Pentium. Even though only 7 of 51 PCs here had Cyrix CPUs, they posted 4 of the top 10 Business Winstone scores (although the top 10 scores were very close together, and most fell within Business Winstone's margin of error). The bottom line? Configure a

Cyrix 6x86-P200+ PC and a Pentium/200 PC with equivalent components such as Fast/Wide SCSI-2 hard disks, caching disk controllers, and cutting-edge graphics engines, and you'll get essentially the same level of performance with mainstream applications.

REVIEW CRITERIA

We asked vendors to supply us with PCs using 200-MHz Pentium or Cyrix 6x86-P200+ CPUs and 16MB of RAM, a 1.6GB or larger-capacity hard disk, a quad-speed or faster CD-ROM drive, a 16-bit sound subsystem, speakers, an SVGA graphics card with a minimum of 2MB of video memory, and at least a 15-inch monitor. We received 51 machines from 41 vendors.

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Editors' Choice

- Personal system: Dell Dimension XPS P200s
- Corporate system: IBM PC 350



One Editors' Choice in this roundup of 200-MHz Pentium and Cyrix PCs is the \$3,179 Dell Dimension XPS P200s, an ideal choice for small businesses—its target market—or for single users looking for a well-stocked PC at a reasonable price. The Dimension

has all of the key hardware and software components that you'll need in a new PC, including a 3GB hard disk, a 17-inch monitor, a V.34 modem, an 8X CD-ROM drive, and a copy of Microsoft Office for Windows 95. And the system is backed by a great three-year-parts, one-year-labor warranty from a vendor that earned a grade of A from *PC Magazine* subscribers on our annual Service and Reliability survey.

Our second Editors' Choice goes to the \$3,870 IBM PC 350. If you're looking for a network-ready corporate desktop and are willing to pay for it, you can't go wrong with this PC. IBM outfits the PC 350 with its DMI-enabled NetFinity client software for system monitoring over the network. With



NetFinity, you can track hardware and software configurations, monitor system performance, and recognize SNMP alerts. The software also supports predictive failure analysis for local hard disks, so you'll be alerted if your disk is about to fail. Add the vendor's Wake-On-LAN card (a \$120 card that supports both Ethernet and Token-Ring) and network administrators can remotely power up the PC to update files, perform asset tracking, and inventory equipment.

IBM didn't forget the hardware in this system either: The PC 350 is fully loaded with a 3GB IBM hard disk, an 8X Hitachi CD-ROM drive, and Cambridge SoundWorks speakers complete with subwoofer. And IBM, like Dell, earned a grade of A on our latest subscriber survey on service and reliability.

FLOATING-POINT UNIT FLOUNDERS

While the 6x86 can ably keep up with the Pentium, all is not sweetness and light with this CPU. A key reason behind this processor's success on our Business Winstone 97 test is that the mainstream applications that make up this test rarely use the chip's floating-point unit (FPU). We've found that the FPU in the Cyrix chip is not as adept as the Pentium's, which means that users of some games or high-end CAD-CAM applications will suffer a clear performance penalty in using the Cyrix 6x86-P200+ (see "What the Numbers Mean" in "Beyond the Pentium," May 28, 1996, for more details). Cyrix asserts that the 6x86's FPU performance is essentially the same as the Pentium's, except on software written specifically to take advantage of the Pentium FPU's architecture.

The 6x86 CPU also runs hotter and draws more current than the Pentium/200 (a few reports of heat problems with Cyrix's CPU have cropped up recently). Cyrix, however, claims that the heat sink and fan that ship with its 6x86 provide sufficient cooling. The Cyrix chip does dissipate more power than the Pentium (15 to 20 watts, versus the Pentium's 8 to 16 watts), although both are 3.3-volt CPUs.

On the software side, although there are no Windows 95 incompatibilities with Cyrix, Microsoft detected a problem with the 6x86 and Windows NT 4.0. The current fix requires Windows NT 4.0 to set the 6x86 internal cache to write-through mode instead of write-back mode, which Cyrix acknowledges will reduce overall performance by about 25 percent. Cyrix says that chip revisions have solved the problem, and that new processors and patch software will be sent to any current users of 6x86 chips who have trouble with Windows NT 4.0.

THE ROAD AHEAD

Cyrix offers Pentium-class PC owners one key feature that Intel doesn't: an upgrade path. The road from a Pentium to a Pentium Pro starts with a new motherboard. The upcoming MMX-enhanced Cyrix M2 processor, however, will fit into the same 256-pin socket used by the 6x86 and the Pentium, yet is slated to provide performance superior to today's Pentium Pros. Intel has said that MMX-enhanced Pentiums will not be available until early 1997.

While the M2 will be limited by the Pentium-style pinout, Cyrix claims that other enhancements will allow the M2 to outperform Pentium Pros. The M2 will use a smaller die than the 0.5-micron 6x86 series (Pentiums use a 0.35-micron process), and will draw less power, possibly 3.3 volts externally and 2.5 volts internally. Smaller die sizes decrease manufacturing costs and allow for higher internal clock speeds.

Quite silent in the high-end Pentium-class market is AMD, which merged with NexGen, another manufacturer of Pentium challengers. By the time you read this, AMD will have released the AMD K5-PR133, which should deliver performance comparable to a 133-MHz Pentium. AMD plans to produce versions of this CPU to challenge 150-MHz Pentiums. And AMD anticipates engineering samples of its sixth-generation processor, the K6 (a NexGen-based design), in late 1996.

WHICH TO CHOOSE?

If this roundup proves one thing, it's that you can't judge a PC by its CPU alone. We've concluded that when two PCs are similarly equipped, the Pentium and the 6x86 run neck and neck. What's the final word on the Pentium-versus-6x86 battle? The choice is yours. Let the reviews on the following pages help you decide.

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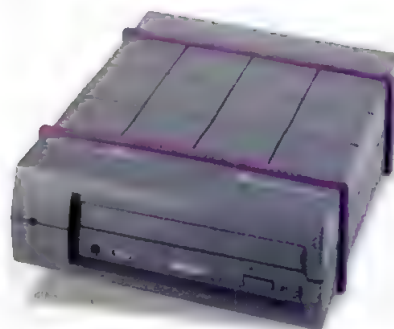


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Price/Performance Index: Pentium and Cyrix PCs

The \$2,899 Cyrix-based Micro Express MicroFlex-686/P200+—the price/performance leader in this roundup—is replete with many high-end components, but it sells for a surprisingly low price. This machine packs a real punch in the performance arena, thanks largely to its 16MB CMD caching disk controller. The MicroFlex-686/P200+ garnered the top ZD Business Winstone 97 score of this roundup.

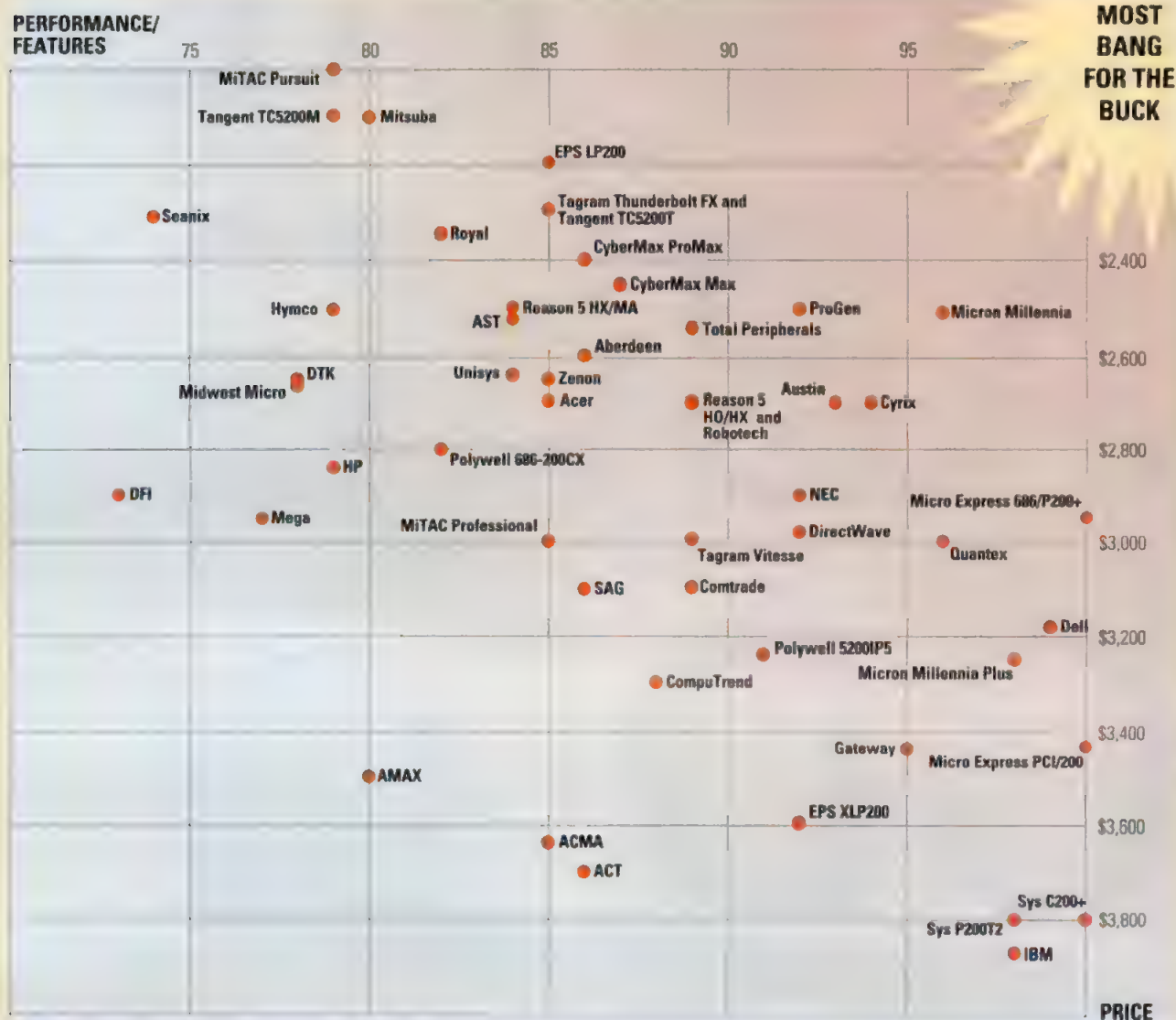
An Editors' Choice also gives you a lot of bang for your buck: the \$3,179 Dell Dimension XPS P200s. Not only

will this machine get the job done in the storage arena with its 3GB hard disk, but its full complement of hardware and software—including a 17-inch monitor, a V.34 modem, a 4MB Number Nine Imagine 128 Series II graphics board, and Microsoft Office Professional for Windows 95—will ensure that you have all the tools you need to be productive.

THE DATA POINTS

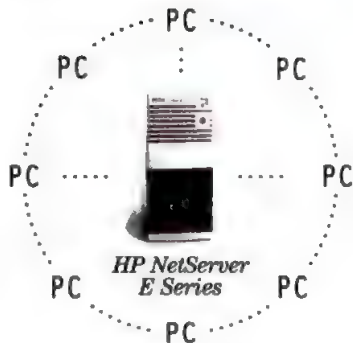
The ZD Business Winstone 97 and ZD CD-ROM WinMark 97 test scores

account for 29 percent of the performance/features score. Postpurchase assistance—specifically, the availability of around-the-clock toll-free telephone support and the term of the included warranty, as well as whether the warranty includes on-site support—counts for 17 percent. Hard disk size, monitor size, and the amount of graphics memory provided count for 16 percent of the performance/features score. The remaining 38 percent depends on certain hardware features, such as top monitor resolution.



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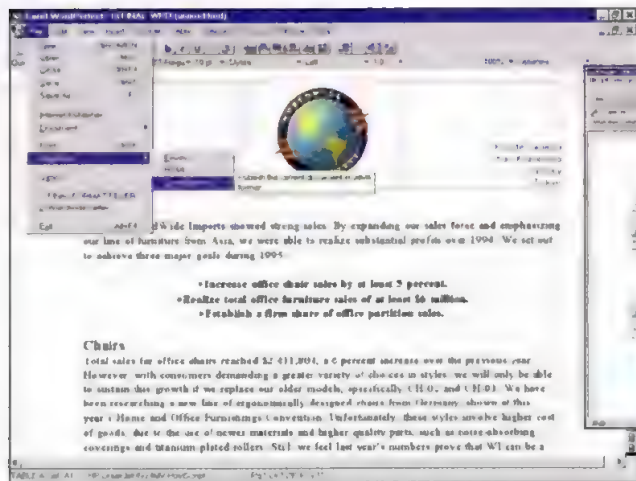
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Aberdeen Inc. **Aberdeen P5-200SE**

The Aberdeen P5-200SE (\$2,595 direct) mates an appealing price with good performance, making it a good choice for its target audience of value-minded buyers. Other lines include the Cyrix-based Aberdeen Power6 and the Aberdeen Pro and Dual Pro lines, both based on Pentium Pro chips.

This unit has a SuperMicro motherboard with Intel's 430HX chip set, EDO memory, and 512K of pipelined-burst L2 cache. Graphics in the tested unit were driven by an STB Light-speed graphics card; storage was handled by a 2GB Seagate Fast ATA-2 hard disk. These features helped the unit achieve average results on our benchmark tests, except for an above-average CD-ROM WinMark 97 score, which can be attributed to the 8X Toshiba CD-ROM drive.

Sound is provided by a Creative Labs FM and wavetable synthesis card and a set of integrated speakers, which are screwed into the base of the 17-inch KDS monitor. Remaining hardware includes a U.S. Robotics 33.6/14.4-Kbps data/fax/voice modem and a Microsoft Natural keyboard. The company also bundles a number of games, such as TerraNova, Earth Siege 2, Silent Thunder, and a game sampler CD.

With an aggressive price and average performance, the Aberdeen P5-200SE is worth a close look.—*Frank J. Evans*
Aberdeen P5-200SE. Direct price: \$2,595. Aberdeen Inc., Santa Fe Springs, CA; 800-552-6868, 310-801-5626; fax, 310-801-5629; www.aberdeeninc.com. Circle 441 on reader service card.

Acer America Corp. **AcerPower Pentium 200MHz**

The AcerPower Pentium 200MHz seeks to provide a cost-conscious solution for the midrange corporate buyer. Its \$2,700 street price is certainly attractive, and this DMI-compliant unit offers mostly average performance. Acer also markets the Acer Aspire line of home machines.

The AcerPower's easy-to-open, tool-free mini-tower chassis houses two of the unit's Acer-built components, its Acer V35 motherboard and 8X CD-ROM drive (the keyboard and monitor are also built by Acer). The motherboard supports Intel's

430HX core-logic chip set, 256K of pipelined-burst L2 cache, and EDO DRAM.

The Diamond Stealth 3D 2000 graphics card, geared for 3-D graphics work, was hooked to a 15-inch AcerView monitor, which provided clear output. The card helped the unit to an average Graphics WinMark 97 score. Storage was handled by a 2GB Seagate Fast ATA-2 hard disk, which doubtless contributed to the system's average Winstone 97 and Disk WinMark 97 scores.

The unit also came with a Creative Labs sound card supporting FM synthesis and Soundforce speakers that provided decent sound output. It included DMI software for managing the machine over a network, but it had no MIF browser.

Competitive performance, an easy-to-maintain case, and an appealing price make this unit a good corporate buy.—*FJE*

ACMA Computer Inc. **zPower 200**

ACMA aims its zPower 200 at high-end corporate users who want brand-name features at a reasonable price. The zPower (\$3,695 direct) hits the mark, with its removable hard disk, Impression PC Card drive, and competitive performance on our benchmark tests.

The zPower makes maintenance a snap with a slide-out Tyan motherboard; an easily removable 2GB Seagate hard disk is also convenient for servicing or for those who have security concerns. The motherboard has two DIMM slots and four SIMM slots (they can't be used at the same time); the test unit had one 16MB EDO DIMM module. The unit was an average performer except for an above-average CD-ROM WinMark score.

The system has a 4MB Matrox MGA Millennium graphics card and an ADI 17-inch monitor, which provide a clear image. For multimedia tasks, it includes an 8X Toshiba CD-ROM drive, a Creative Labs sound card that is FM-synthesis capable, and Altec Lansing speakers that offer clear sound. It also comes with a U.S. Robotics 28.8/14.4-Kbps data/fax modem, a Microsoft Natural keyboard, and an MLI microphone. Microsoft Office Professional and The Computer Language Co.'s Computer Reference



AcerPower Pentium 200MHz. Street price: \$2,700. Acer America Corp., San Jose, CA; 800-733-2237, 408-432-6200; www.acer.com/aac. Circle 442 on reader service card.

zPower 200. Direct price: \$3,695. ACMA Computer Inc., Fremont, CA; 800-786-6888, 510-623-1212; fax, 510-623-0818; www.acma.com. Circle 443 on reader service card.

Bravo MS-T 5200. Street price: \$2,520. AST Computer, Irvine, CA; 800-876-4278, 714-727-4141; fax, 714-727-8597; www.ast.com. Circle 446 on reader service card.

Library are also included.

While it's priced higher than many here, the zPower's user-friendly design and components make it a reasonable choice for corporate users.—FJE

All Computer Technology **ACT P5-200CD**

The ACT P5-200CD (\$3,698 direct) is aimed at high-end corporate users looking for good value, and it largely provides this, except for some below-average benchmark test scores. It comes with a host of extras, including a Nakamichi 8X CD-ROM drive that can hold up to four CDs, an Ultra SCSI hard disk, and Lotus SmartSuite 96.

The unit's mostly below-average scores were surprising, given its components. Despite a SuperMicro motherboard, Intel's 430HX chip set, and 512K of L2 cache, it garnered below-average CPUmark scores. A Number Nine Imagine 128 Series II graphics card helped pull the system's Graphics WinMark 97 and Winstone 97 scores up to average, however.

The P5-200 is packed with features. Its motherboard slides out easily, facilitating maintenance; and its keyboard has a built-in touch pad and a jack for a serial mouse. A 33.6/14.4-Kbps fax modem is included and supports both caller ID and voice mail functions, and the 15-inch MAG monitor provides a clear image. Remaining hardware includes an Adaptec ultrawide disk controller card (which handles both the SCSI CD-ROM drive and a 2GB Seagate Ultra SCSI hard disk), a Creative Labs wavetable sound card, and MIDI Land MLI speakers.

Its price may be higher than that of the average PC reviewed here, but compelling peripherals and mostly adequate performance make the ACT P5-200CD worth a look.—FJE

ACT P5-200CD. Direct price: \$3,698. All Computer Technology, City of Industry, CA; 800-775-1953, 818-369-4181; www.allcomp.com/acw. Circle 444 on reader service card.

AMAX Engineering Corp. **AMAX Power Station GFX-5200**

The AMAX Power Station GFX-5200 (\$3,499 direct) is billed as a top-of-the-line PC for corporate graphics power users.

An Impression motherboard had a special turbo jumper to boost the speed of the CPU from 200 MHz to 205 MHz. Intel suggests that PCs not be run faster than the CPU's rated clock speed (if the CPU burns out while running at 205 MHz, Intel will invalidate its warranty). We tested with the turbo jumper disabled, which is the default configuration as sold.

Outfitted with 512K of L2 cache and SDRAM, the unit posted average numbers on most tests. The unit did manage above-average scores on our Disk WinMark 97 tests, aided by a Fast/Wide SCSI-2 hard disk, and above-average marks on our CD-ROM WinMark 97 tests, boosted by an 8X Plextor CD-ROM drive.

One of the more interesting components is the 33.6/14.4-Kbps Impression Web modem (bundled with Netscape) that supports a full-duplex speakerphone. You may want to upgrade the low-end FM-synthesis Creative Labs sound card and Kingtex speakers, however.

Power users will be satisfied with this machine's components and performance, but watch that motherboard turbo jumper.—FJE

AMAX Power Station GFX-5200. Direct price: \$3,499. AMAX Engineering Corp., Fremont, CA; 800-800-6328, 510-651-8886; fax, 510-651-4119; www.amax.com. Circle 445 on reader service card.

AST Computer **Bravo MS-T 5200**

Although the AST Bravo MS-T 5200 costs only \$2,520 on the street, its lackluster set of components and poor test scores may dissuade some buyers. AST's Bravo MS-T line is aimed at mainstream corporate users. But the Bravo MS-T 5200 certainly resembles the quintessential value PC—one that clearly favors price rather than performance.

Though the Bravo MS-T 5200 has an Intel motherboard, an Intel 430HX chip set, and EDO memory, its performance was handicapped by both its on-board ATI Mach64 VT graphics chip set with 2MB of SDRAM (which was using an old driver) and its 4,500-rpm 1.9GB hard disk. Such components resulted in this roundup's lowest Winstone 97, Graphics WinMark 97, and Disk WinMark 97 scores. CPUmark performance was average, and the CD-ROM WinMark 97 score was below average because of the 4X CD-ROM drive (an 8X drive will be standard by the time you read this).

This mini-tower is very short on space: There were no drive bays available on our test model. Sound was provided through an integrated chip set and a set of Labtec speakers. On the bright side, the unit is DMI-compliant, and includes AST Command Center software for monitoring desktop functions.

Even at its low price, the Bravo MS-T 5200 remains a disappointing PC.—CM

Austin Computer Systems **Austin PowerPlus 200**

Austin Computer Systems' Austin PowerPlus 200 midtower combines an admirable direct price (\$2,699) with respectable scores on our benchmark tests. It also offers a modem and a soft power-down feature. Austin's PowerPlus machines are aimed at the high-end corporate and government markets, while its Power System line is sold to more value-minded business customers. Austin also offers an Austin Élan line of Pentium Pro workstations.

Using a 2GB EIDE hard disk and an STB Lightspeed 128 graphics card, the unit garnered solidly average test scores. The system's core is built around an Intel Tucson motherboard, the Intel 430HX chip set, and EDO DRAM.

The PowerPlus 200's multimedia components included an 8X ATAPI CD-ROM drive, two Micro Innovations MM40P speakers, and integrated sound that supports both wavetable and FM synthesis. A 28.8/14.4Kbps modem was also included, but it had no telephony functions. The system came with a 17-inch monitor.

The PowerPlus 200 provides solid performance and an attractive component set at a fair price.—CM

Austin PowerPlus 200. Direct price: \$2,699. Austin Computer Systems, Austin, TX; 800-752-1577, 512-339-3500; fax, 512-454-1357; www.austindirect.com. Circle 447 on reader service card.

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*Model 269/369. †Estimated IBM authorized retailer price. Actual prices may vary. Other models range up to \$3,499. MHz denotes internal clock speed of the microprocessor only; other factors also affect application performance. ‡On selected models. §MB = million bytes, GB = billion bytes. §SmartSuite may be preloaded, included on a CD, or available to order on a CD. Diskettes and hard copy documentation available at extra charge. ¶M-F, 8 am - 8 pm EST. In Canada, call 1 800 465-3299 (ID# 45294). Also supports Windows NT v3.51 v4.0 (when available). IBM ThinkPad, TrackPoint III and Solutions for a small planet are trademarks of International Business Machines Corporation. Microsoft and Windows are trademarks or registered trademarks of Microsoft Corporation. Other companies, products and service names may be trademarks or service marks of others. © 1996 IBM Corp.

CompuTrend Systems Inc. **Premio HX-P200**

CompuTrend Systems sets the Premio HX-P200 apart with an extremely fast hard disk. A midtower unit (\$3,300 street), it also provides a USB connector, DMI compliance, and a business-oriented software bundle. The Premio HX line is intended for business users. The vendor also markets the FX Pro line of Pentium Pro units and the Premio line of value systems.

The Energy Star-compliant Premio HX has a CompuTrend motherboard, Intel's 430HX chip set, and EDO memory. Its highest-profile feature is a 2GB Quantum Fast/Wide SCSI-2 hard disk. This 7,200-rpm disk turned in an above-average Disk WinMark 97 score that stood out among the machine's otherwise average test results.

The unit also boasts 512K of pipelined-burst L2 cache and a Number Nine Imagine 128 graphics card with 4MB of VRAM. The system came with an 8X Acer ATAPI CD-ROM drive, but CompuTrend will have replaced it with an 8X Mitsumi drive by the time you read this. The Sceptre monitor has a 17-inch diagonal length, supports DDC1 and DDC2, and is Energy Star-compliant. The ESS sound card provides wavetable and FM synthesis, and the unit has two MIDI Land MLI-130 speakers.

CompuTrend ships its PCs with Microsoft Office Professional 7.0. For a machine with average performance and a good hard disk, the Premio HX-P200 is a reasonable choice.—*CM*

Comtrade **Multimedia Wide-SCSI Powerstation 8X**

Comtrade's Multimedia Wide-SCSI Powerstation 8X (\$3,095 direct) is targeted at high-end business users, especially those involved with graphics-intensive tasks such as desktop publishing. With an extensive software bundle, competitive performance, and a cutting-edge modem, the Powerstation surely hits its mark.

With a 2GB Fast/Wide SCSI hard disk, the Powerstation tower delivered average scores on all of our benchmark tests. Comtrade opts for an impressive S3 VIRGE-based Diamond Stealth 3D 2000 graphics card that supports 3-D rendering for high-end gaming and business graphics. Sound is handled by an Aztech Labs ISA card that supports wavetable and FM synthe-

sis and two Premier QX-S12 speakers.

This system offers plenty of room for expansion and ships with a 17-inch Princeton monitor that supports both DDC1 and DDC2. A bundled 33.6/14.4-Kbps modem (with voice mail options), Lotus SmartSuite 96, and Descent II complete the package.

The Powerstation stands out from the crowd for its fast hard disk and solid graphics hardware.—*CM*

Multimedia Wide-SCSI Powerstation 8X. Direct price: \$3,095. Comtrade, City of Industry, CA; 800-969-2123, 818-961-6688; fax, 818-369-1479; www.comtrade-pc.com. *Circle 449 on reader service card.*

CyberMax Computer Inc. **Max I6-P200, ProMax 7 P200+**

CyberMax offers two flavors of Pentium-class PCs to business or SOHO users via two similarly configured machines: the Max I6-P200 (\$2,449 direct) and the Cyrix 6x86-based ProMax 7 P200+ (\$2,399 direct). Each comes with a telephony modem and an abundant software bundle, and both deliver mostly competitive performance.

The Intel-based Max I6-P200 is built around a Biostar motherboard with Intel's 430VX chip set and 512K of L2 cache. With such a system core and an STB LightSpeed graphics card, this midtower turned in average results on our benchmark tests.

The Cyrix 6x86-based ProMax 7 P200+ delivered average scores on all but the Disk WinMark 97 tests, where it fell below average. This mini-tower opts for a DFI Screamer Pro motherboard, a VLSI Lynx chip set, and a VideoLogic Graftix Star 600 graphics card.

CyberMax ships each unit with an 8X ATAPI CD-ROM drive, a 3GB hard disk, an Ensoniq sound card with wavetable synthesis, and two Altec Lansing ACS5 speakers. The units each offer a soft power-down feature and a 28.8/14.4-Kbps telephony modem with voice mail and a full-duplex speakerphone functions.

CyberMax includes Compton's Interactive Encyclopedia 1996, Internet Mania, Corel PrintHouse, Quicken SE, and Corel WordPerfect Suite 7.0 with both of its PCs.

Solid test scores and a low price make both systems attractive options for new or experienced users.—*CM*



Premio HX-P200. Street price: \$3,300. CompuTrend Systems Inc., City of Industry, CA; 800-677-6477, 818-333-5121; fax, 818-369-6803; www.premiopc.com. *Circle 448 on reader service card.*

Max I6-P200. Direct price: \$2,449. **ProMax 7 P200+** (above). \$2,399. CyberMax Computer, Allentown, PA; 800-443-9868, 610-770-1808; www.cybmax.com. *Circle 450 on reader service card.*

Dimension XPS P200s. Direct price: \$3,179. Dell Computer Corp., Austin, TX; 800-613-3355, 512-338-4400; fax, 800-727-8329; www.dell.com. *Circle 452 on reader service card.*

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Cyrix Corp. **Cyrix 6x86-P200**

In an effort to give its 6x86 CPU a higher profile, Cyrix Corp. has teamed with Electronic Data Systems (EDS) to build and sell its own line of PCs. Ironically, the \$2,699 Cyrix 6x86-P200 turned in the lowest test scores of the seven 6x86 PCs reviewed here. Compared with the overall group, however, it posted average scores. The unit is aimed at high-end corporate buyers and small-business users.

The 6x86-P200 mini-tower offers a DFI motherboard with a VLSI Lynx chip set and 256K of L2 cache. When compared with other P200+ PCs, the unit had the lowest CPUmark scores as well as the lowest Graphics WinMark 97 score. The Matrox MGA Millennium graphics card and an 8X ATAPI CD-ROM drive helped it achieve average test scores in the roundup as a whole. The unit was unable to run our 900-Kbps video clip test, however, and its Disk WinMark 97 score was below average for this roundup.

The system ships with two Labtec LCS-2612 speakers that attach to the side of a 17-inch MAG monitor, which supports both DDC1 and DDC2. A Creative Labs sound card supports wavetable and FM synthesis. Cyrix now ships a free copy of Lotus SmartSuite 96 with its PCs.

As an alternative to Pentium-based PCs, this unit certainly holds its own.—*CM*

Cyrix 6x86-P200. Direct price: \$2,699. Cyrix Corp., Richardson, TX; 800-340-7501, 214-968-8388; fax, 800-340-7463; www.cyrix.com. Circle 451 on reader service card.

Dell Computer Corp. **Dimension XPS P200s**



The Dimension XPS P200s (\$3,179 direct) is such an ideal machine for the small-office/home-office set that we awarded it our Editors' Choice. Users can enjoy a tool-free chassis, a V.34 modem, and a copy of Microsoft Office for Windows 95—and good performance to boot.

The Dimension XPS mini-tower is based on an Intel motherboard with 512K of L2 cache and DIMM-form-factor SDRAM. The system's Number Nine Imagine Series II graphics card and 3GB IBM Fast ATA-3 hard disk aided in producing highly competitive Winstone 97, Disk WinMark 97, and Graphics WinMark

97 scores. Using an 8X Sony CD-ROM drive, the unit posted a CD-ROM WinMark 97 score that was also average.

The XPS boasts Dell's UltraScan 17LS monitor and two Altec Lansing ACS31 speakers. A Creative Labs sound card supports wavetable and FM synthesis. Besides a copy of Microsoft Office, Dell includes a V.34 28.8/14.4-Kbps modem (33.6/14.4-Kbps modems will be standard by the time you read this).

The good performance of the Dimension XPS P200s and its user-friendly design should please buyers.—*CM*

DFI **Landmarq VPS Plus**

The Landmarq VPS Plus (\$2,900 street) is one of seven PCs in our roundup to use Cyrix's 6x86-P200+ CPU, but its performance on our tests was brought down by a slow hard disk. The system is meant as a midrange corporate unit.

The Landmarq delivered barely average scores on all of our benchmark tests. Such performance can be traced back to its 1.6GB Quantum Sirocco hard disk that spins at only 4,500 rpm.

The rest of the system's components, however, are admirable; these include a Matrox MGA Millennium graphics card with 2MB of WRAM, an 8X Mitsumi CD-ROM drive, and EDO memory. Like all Cyrix P200+ customers, DFI does not use Intel hardware; its motherboard is manufactured in-house, while its chip set is a VLSI Lynx model. This Energy Star-compliant mid-tower—which has ample room for expansion—derives its sound from a DFI card that supports FM synthesis and two MIDI Land MLI-691 speakers. The Landmarq also had an Energy Star-compliant Esprit 15-inch monitor.

If top-level hard disk performance is not a concern, this unit offers just enough performance for most users.—*CM*

Landmarq VPS Plus. Street price: \$2,900. DFI, Sacramento, CA; 800-808-4334, 916-568-1234; fax, 916-568-1233; www.dfiusa.com. Circle 453 on reader service card.

DirectWave Inc. **P200 MVP ProLS**

For a direct price of only \$2,979, DirectWave's P200 MVP ProLS delivers nearly everything the average corporate user

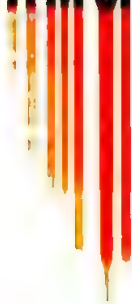


P200 MVP ProLS. Direct price: \$2,979. DirectWave Inc., Ontario, CA; 800-882-8108, 909-390-8098; fax, 909-390-8060; www.directwave.com. Circle 454 on reader service card.

Quin-55M/P200. Street price: \$2,650. DTK Computer Inc., City of Industry, CA; 800-889-8998, 818-810-0098; fax, 818-810-0098; www.dtkcomputer.com. Circle 455 on reader service card.

EPS LP200. Direct price: \$2,195. **EPS XLP200** (above). \$3,595. EPS Technologies Inc., Jefferson, SD; 800-447-0921, 605-966-5586; www.epstech.com. Circle 456 on reader service card.

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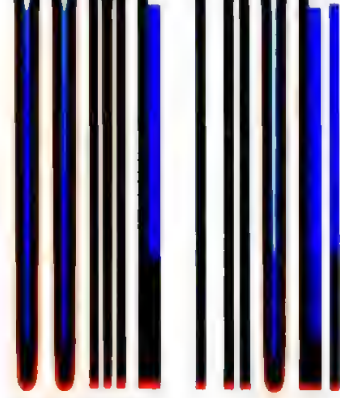
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BENCHMARK TESTS

Pentium and Cyrix PCs



Equipped with comparable components, both the Pentium and Cyrix PCs that we tested in this roundup delivered on our benchmark tests. Key components of top performance included caching disk controllers and Fast/Wide SCSI-2 hard disks.

What the Numbers Mean

ZD Business Winstone 97 and ZD High-End Winstone 97

Our new 32-bit test suite, ZD Winstone 97, is divided into two test segments: ZD Business Winstone 97 focuses on mainstream business applications, and ZD High-End Winstone 97 emphasizes CPU- and graphics-intensive applications. For the Pentium-class PCs reviewed here we ran only the Business portion of our Winstone tests.

EDO and synchronous DRAM (SDRAM), Fast/Wide SCSI-2 hard disks, 512K of L2 cache, and 16MB caching disk controllers were the components that gave systems maximum performance. Caching disk controllers were major forces behind our top three Business Winstone finishers: the Micro Express MicroFlex-686/P200+, Micro Express MicroFlex-PCI/200, and Zenon Presentation P200. The top Cyrix system, the MicroFlex-686/P200+, bested the top two Pentium units by only 1 point on these tests.

ZD Business Graphics WinMark 97 This roundup gave us our first look at the new Tseng ET6000 chip set, which uses *Multibank DRAM* (MDRAM). The Cardexpert Technology Challenger EV, STB Lightspeed 128, and VideoLogic GraftixStar 600 graphics boards each used this chip set. The ET6000 is a 128-bit GUI accelerator with an integrated 135-MHz RAMDAC.

MDRAM, manufactured by MoSys, organizes DRAM into independent 32K banks. These banks can be active at any time, on the same device. Also, if a request for an inactive address occurs, the row-access operation can occur in parallel with the read or write operation. This partially "hides" access latency and boosts MDRAM's performance. MoSys claims that MDRAM should show better performance when tested in a multiplexed scenario. Multiplexing in a graphics subsystem may involve the video controller, system interface, bit-block-transfer (BitBlt) engine, and display controller, all of which must access graphics memory simultaneously. A test incorporating a graphics subsystem, video controller, and system interface will best show off MDRAM's features. On our ZD Graphics WinMark 97 test (a single-scenario graphics test), systems with ET6000-/MDRAM-based graphics cards performed about average.

The top performers on our Business Graphics WinMark tests were systems using Number Nine's Imagine 128 Series II and Diamond's Stealth 3D 2000 (the latter based on S3's ViRGE chip set) and the Matrox MGA Millennium board. The ViRGE chip set is a 64-bit 2-D GUI and video accelerator with an integrated 135-MHz RAMDAC. The ViRGE chip set has all the 3-D-rendering capabilities of its sibling, the S3 Trio64V+, and adds perspective correction, bilinear and trilinear texture filtering, mip mapping, depth cuing and fogging, alpha blending, video texture mapping, and z-buffering.

ZD Business Disk WinMark 97 As seen in our last Pentium Pro roundup ("Power to the People," September 24, 1996), a caching disk controller can give a performance boost to a SCSI-based system during disk testing. The MicroFlex-686/P200+ and MicroFlex-PCI/200 each used a Quantum Atlas XP32150W Fast/Wide SCSI-2 disk with a rotational speed of 7,200 rpm, while the Zenon Presentation P200 used an IBM Ultrastar DORS-32160 Fast/Wide SCSI-2 disk with a rotational speed of 5,400 rpm. Each of these three PCs used a CMD Technologies CMD CSA-6520W disk controller with 16MB of cache. The controller gave these units about a 24 percent performance boost during Business disk testing over their nearest competitors. Although these three PCs were among the top performers on the Business Winstone tests, the disk controller was not as much of a factor: All three posted Winstone scores that were only about 5 percent better than those of their nearest competitors.

SCSI-based PCs without caching disk controllers posted Business Disk WinMark scores that were about 21 percent higher than scores posted by units with IDE disks. The SCSI advantage over IDE is less conspicuous but was still noticeable on our Winstone tests, resulting in roughly an 8 percent performance increase.

ZD CPUmark₁₆ and ZD CPUmark₃₂ The processor battle between heavyweight Intel and new contender Cyrix resulted in close scores, but the edge went to Intel. Pentium-based PCs in this roundup posted CPUmark scores that were about 4 percent higher than the CPUmark scores of Cyrix 6x86-P200+-based machines.

When we were acquiring PCs for this roundup, the only vendor shipping a Cyrix 6x86-P200+ motherboard was DFI (with VLSI's Lynx chip set). Since then, however, FIC has begun shipping a board with a VIA chip set, and SiS has a board in production. The Pentium, conversely, has a much wider range of choices for surrounding components. Intel's newest Pentium chip set, the 430 PCiset, comes in two flavors: the 430VX and the 430HX. The biggest difference between the two is that the 430VX is usually paired with SDRAM, which the 430HX doesn't support. Memory types didn't make too much of a difference on our CPUmark tests, however; SDRAM-based PCs outscored the non-SDRAM systems by only 3 percent on both CPUmark measures.

The amount of L2 cache installed also played a major role in test scores. On the CPUmark measures, systems with 512K of L2 cache posted scores that were on average 5 to 8 percent higher than scores posted by systems with 256K of L2 cache.

ZD CD-ROM WinMark 97 and Multimedia Tests The ZD CD-ROM WinMark 97 and multimedia tests remain basically unchanged from last year's tests. What we did change were the video clips that we've chosen to run; our high-quality clip is now a Cinepak, 640-by-480, 30-fps, 900-KBps sample that stresses video/graphics and CD-ROM subsystems to a greater degree than the previous clip. The 900-KBps clip proved more than a match for all but the few optimally tuned systems. Systems with Matrox MGA Millennium boards and Tseng ET6000-based graphics cards were best able to handle the 900-KBps clip and dropped the fewest frames. The EPS XLP200 gave us our first look at a 12X CD-ROM drive: the Mitsumi CRM-CFX120T. It lived up to expectations, helping the EPS XLP200 post the highest ZD CD-ROM WinMark 97 score of the roundup. The majority of systems came with 8X drives. Among these, the top performers used the Plextor Px83CS,

Toshiba XM-5602B, and TEAC CD-58E drives.—*Analysis written by Richard Fisco*

How We Tested

We tested all systems with 1.6GB or larger hard disks, 4X or faster CD-ROM drives, and 16MB of RAM. We used each vendor's preinstalled graphics driver for 1,024-by-768 resolution with 64K colors, small fonts, and a refresh rate of 75 Hz.

We used our **ZD Winstone 97, Version 1.0**, benchmark test suite to measure PC performance when running 32-bit Windows 95 applications. Winstone 97 is divided into two categories: ZD Business Winstone 97, focusing on mainstream applications, and ZD High-End Winstone 97, which emphasizes CPU- and graphics-intensive applications. For this part of our roundup, we ran only Business Winstone, which measures the time a PC takes to execute a set of application scripts that exercise eight of the best-selling Windows 95 applications. Business Winstone weights a given PC's timings based on the applications' unit market shares. It derives a composite number and converts it to a relative score. (The score is relative to the performance of a Gateway 486DX2/66 with 16MB of RAM, whose score is defined as 10.)

The **ZD Business Graphics WinMark 97** score, a number based on a log of GDI operations used in the Business Winstone suite, represents the performance of each machine's graphics subsystem under Windows 95. Scores are normalized to reflect performance relative to the base system used for Business Winstone testing. The **ZD Business Disk WinMark 97** score, based on a log of disk functions used in the Business Winstone suite, represents the performance of each machine's disk subsystem under Windows 95. Results are reported in thousands of bytes per second and then converted to a harmonic mean weighted in the same way as the Business Winstone results.

The **ZD CPUmark16** and **ZD CPUmark32** scores reflect the speed of a PC's processor subsystem—which includes the CPU, secondary cache, and system RAM—under 16- and 32-bit operating systems, respectively.

The **ZD CD-ROM WinMark 97** tests gauge the performance of each machine's CD-ROM subsystem. The tests are based on a profile of six of today's most popular Windows CD-ROMs. We report the results of the **CD-ROM Sequential 16K Read** tests, which measure the throughput of a CD-ROM subsystem as it reads 16K blocks of data on a CD-ROM. The **CD-ROM Access Time** score measures CD-ROM drive performance as it randomly accesses 2K blocks from the entire CD-ROM. The **CD-ROM CPU Utilization** score represents the percentage of the CPU's bandwidth occupied by servicing the CD-ROM subsystem as it retrieves data. To determine the utilization, WinBench 97 uses a default block size of 16K. The transfer rate defaults to the maximum rate of your particular CD-ROM subsystem. WinBench 97 then calculates this transfer rate before it runs the actual test.

WinBench 97 also includes a suite of video clips that measure a PC's ability to play full-motion .AVI files. We test video playback performance with two types of clips at a variety of data and frame rates, using either an Indeo or a Cinepak codec. We report results from the **Full-Screen Scaling** tests, which use an Action Indeo, 160-by-120, 30-fps, 300-Kbps clip, and the **High-Quality Action Cinepak** tests, which use a Cinepak, 640-by-480, 30-fps, 900-Kbps video clip.

desires in a PC. This Energy Star-compliant mid-tower—which is aimed at those who do CAD work or desktop publishing—supplements many adept components with attractive extras such as an IrDA infrared port and DMI compliance.

The P200 MVP ProLS produced average results on most of our tests. Its above-average performance on our Disk WinMark 97 test is directly attributable to its 2GB 7,200-rpm Fast/Wide SCSI-2 hard disk, hooked to an Adaptec ultrawide controller. Graphics chores are handled by an STB Lightspeed 128 graphics card with 2MB of MDRAM. An 8X Toshiba CD-ROM drive helped produce an above-average CD-ROM WinMark 97 score.

The unit offers good multimedia support in the form of a MAG 17-inch monitor (DDC1- and DDC2-compliant), two Macase SK-A30 speakers, and a Creative Labs Sound Blaster AWE32 sound card capable of wavetable synthesis. DirectWave also includes two USB ports, a 33.6/14.4-Kbps modem, headphones, and a microphone.

DirectWave bundles a copy of Lotus SmartSuite 96 with the unit. With its superior disk performance and attractive components, the P200 MVP ProLS is worth a close look.—*CM*

DTK Computer Inc. **Quin-55M/P200**

As the centerpiece of DTK's high-end PC line, the Quin-55M/P200 (\$2,650 street) is aimed at demanding corporate and government users. This midtower PC has a few distinguishing extras; however, it garnered some mixed results on our benchmark tests. DTK also sells Quin-55 corporate midrange systems and a Quin-61 line for the SOHO set.

The Quin's performance was hindered by below-average CPUmark scores; its 4,500-rpm 1.5GB Quantum Fast ATA-2 hard disk contributed to a below-average Disk WinMark 97 score. Using an STB Lightspeed graphics board with 2MB of MDRAM, however, the Quin managed average Winstone 97 and Graphics WinMark 97 scores. An 8X Sony CD-ROM drive also helped the system achieve an average CD-ROM WinMark 97 score.

Sound was provided by a Creative Labs card with FM synthesis and two Lansonic TVS speakers. This Energy Star-compliant system also ships with an ADI MicroScan 17-inch monitor (DDC1 and DDC2 support), and an ergonomic Microsoft keyboard. DTK includes a large software bundle with packages such as Microsoft Works for Windows 95, Money for Windows 95, and Encarta '95, along with several gaming titles.

A bargain price that includes a 17-inch monitor strengthens the appeal of this unit for value-oriented buyers.—*CM*

EPS Technologies Inc. **EPS XLP200, EPS LP200**

The EPS LP200 (\$2,195 direct) and EPS XLP200 (\$3,595 direct) hit their marks: The inexpensive LP200 is an excellent choice for value-minded SOHO buyers, while the fast XLP200 will satisfy demanding corporate users. Both augment strong performance with Fast Ethernet cards and telephony modems.

The LP200 turned in average scores on our tests despite its bargain price, thanks to such components as a Diamond

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- Windows 95 Enhanced Keyboard
- Genuine Microsoft Mouse 2.0
- **PC Magazine Editor's Choice**
- **Panasonic S17 .27dp Digital PnP 17" Monitor**
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BENCHMARK TESTS

▲ Higher scores represent better performance.
▼ Lower scores represent better performance.
Bold type denotes first place.

	ZD Business Winstone 97 Score	ZD Business Graphics WinMark 97 Score	ZD Business Disk WinMark 97 Thousands of bytes per second	ZD CPUmark ₁₁ Score
Aberdeen P5-200SE	34	48.3	582	368
AcerPower Pentium 200MHz	31	42.4	597	344
ACMA iPower 200	33	47.9	577	345
ACT P5-200CD	31	44.7	538	314
AMAX Power Station GEX-5200	36	48.5	727	374
AST Bravo MS-T 5200	27	32.9	438	348
Austin PowerPlus 200	33	48.9	586	348
CompuTrend Premio HX-P200	35	48.5	721	380
Contrade Multimedia Wide-SCSI Powerstation 8X	35	48.8	688	372
CyberMax Max iB-P200	34	44.0	618	353
CyberMax ProMax 7 P200+	35	47.8	551	340
Cyrix 6x86-P200*	30	42.1	479	319
Dall Dimension XPS P200e	36	51.8	652	377
DFI Landmark VPS Plus*	32	46.4	582	335
DirectWave P200 MVP ProLS	36	48.6	734	370
DTK Quin-55M/P200	30	41.5	541	314
EPS XLP200	34	42.9	734	355
EPS UP200	32	44.1	587	362
Gateway P5-200 FPC	33	48.7	602	360
HP Vectra VL 5/200 MT Series 4	33	47.4	690	343
Hymos User 200	32	48.5	545	355
IBM PC 350	35	49.4	658	367
Mega Impact Pentium 200+	38	52.4	708	379
Micro Express MicroFlex-PCI/200	38	48.9	732	379
Micro Express MicroFlex-686/P200+	38	50.4	915	348
Micron Millennia Plus	35	52.4	636	364
Micron Millennia	34	51.8	558	367
MidWest Micro P5-200 Office PC	33	49.2	537	366
MITAC Professional 430H	35	48.6	668	363
MITAC Pursuit 430V	33	47.9	570	360
Mitsuba Premier System-200	33	44.9	576	367
NEC PowerMate P2200	32	38.8	668	353
Polywell Poly 5200IPS	36	48.6	715	367
Polywell Poly 686-200CX*	36	42.8	745	348
ProGen Discover/MPEG II P200	32	43.2	567	368
Quantex QP5/200 SM-2	34	46.7	631	365
Reason Square 5 HQ/HX	36	52.0	732	378
Reason Square 5 HX/MA	33	49.3	553	348
Robotech Cobra XLT 200	32	48.2	559	348
Royal Power Media-15	35	47.0	750	361
SAG STA Pentium 200	35	47.8	683	348
Seenix ASI 9000	29	35.6	589	350
Sys Performance P200T2	36	50.3	700	381
Sys Performance C200+*	37	50.2	676	360
Tagram Thunderbolt FX	34	51.0	588	359
Tagram Vitesse Virtual Studio*	37	48.7	758	325
Tangent TCS200T	34	48.2	589	362
Tangent TCS200M	34	46.9	571	362
Total Peripherals Thunder	33	48.8	605	356
Unisys Aquanta DM	35	50.6	563	368
Zenon Presentation P200	36	48.6	906	382

BETTER ►

BETTER ►

BETTER ►

BETTER ►

(1) With an Action, Indeo, 160-by-120, 30-fps, 300-Kbps clip scaled to full screen (1,024-by-768). (2) With an Action, Cinepak, 640-by-480, 30-fps, 900-Kbps clip.

ZD CPUmark ₃₂ Score	ZD CD-ROM WinMark 97 Thousands of bytes per second	CD-ROM Sequential 16K Read (KBps) ▲	Access Time (ms) ▼	CPU Utilization ▼	Full-Screen Scaling ¹ Frames Dropped ▼	CPU Utilization ▼	High-Quality Action Cinepak ² Frames Dropped ▼	CPU Utilization ▼
370	807	1,210	145	53%	0	96%	51	95%
329	669	1,190	200	55%	0	96%	202	94%
338	804	1,210	149	32%	0	94%	27	94%
306	633	1,220	196	10%	29	95%	75	91%
375	841	1,210	132	7%	0	95%	26	93%
342	536	922	246	42%	9	94%	191	95%
344	784	1,220	162	8%	0	95%	15	94%
362	676	1,200	193	54%	99	94%	369	93%
375	780	1,230	167	53%	3	95%	146	87%
359	788	1,210	158	54%	0	96%	130	95%
349	757	1,100	146	72%	15	94%	395	98%
317	687	1,210	181	81%	2	95%	⊗	⊗
383	778	1,210	171	31%	66	94%	57	93%
342	708	1,220	157	49%	0	94%	56	93%
374	806	1,210	144	54%	0	96%	36	94%
305	684	1,210	167	9%	⊗	⊗	437	21%
349	845	1,790	189	40%	0	96%	74	93%
363	749	1,220	168	46%	0	95%	180	94%
355	817	1,210	143	8%	0	96%	73	90%
333	419	606	266	28%	2	94%	440	52%
350	638	908	175	22%	4	94%	432	52%
363	756	1,220	168	29%	0	95%	30	93%
375	809	1,240	143	46%	N/A	N/A	255	97%
374	757	1,220	173	53%	0	96%	10	96%
365	744	1,220	172	79%	7	95%	389	95%
366	755	1,210	139	18%	0	95%	14	94%
367	750	1,220	170	54%	3	95%	64	94%
369	678	1,180	198	53%	101	94%	330	95%
367	807	1,220	169	54%	0	95%	45	94%
360	801	1,220	168	54%	0	96%	24	95%
365	756	1,220	177	54%	3	95%	25	95%
345	675	1,200	176	29%	2	95%	51	94%
377	825	1,220	141	54%	0	96%	25	96%
353	758	1,110	149	73%	2	96%	440	87%
361	810	1,210	147	54%	0	94%	54	95%
367	578	1,210	149	46%	0	96%	0	98%
374	814	1,220	137	54%	3	94%	116	94%
348	822	1,220	138	28%	2	94%	50	92%
345	662	1,150	202	44%	6	95%	245	97%
368	780	1,220	161	46%	0	96%	25	95%
350	736	1,200	155	8%	36	94%	32	93%
347	693	1,210	186	66%	10	95%	428	88%
384	813	1,220	138	53%	0	95%	55	94%
372	812	1,220	137	80%	0	96%	382	94%
359	815	1,210	143	34%	0	94%	25	95%
332	707	1,020	163	5%	0	96%	50	93%
377	807	1,210	147	54%	0	95%	32	95%
372	815	1,210	146	8%	0	96%	61	93%
345	675	1,180	241	54%	0	96%	66	94%
367	809	1,210	146	54%	107	94%	270	94%
369	628	917	178	5%	0	96%	439	21%

BETTER ►

BETTER ►

* These systems use the Cyrix 6x86 P200+ processor, all others use Pentium/200s

⊗ This unit's performance was too poor to measure

N/A—Not applicable. The product did not complete this test

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PC Buyers' Guide

In the market for a PC? Whether you're looking for a corporate Windows NT workstation, a general business machine, or a PC the whole family can use, we've put together some configuration guidelines to help you out. We list our recommendations along with a buyers' worksheet, so you can compare our suggestions

with what you're considering to buy. Consult the illustrations and captions on the following pages to read our reasoning behind some recommendations—or to get more information if you plan to run more demanding applications on your new PC, such as CAD software. Finally, have these lists by the phone if you call a direct vendor, or in your hand if you go to a computer reseller or superstore.

Below you'll also find information on where to buy your new PC, as well as support and web site information on many of today's top system vendors (according to recent market-share data).

Where to buy: There are several types of PC vendors. A *direct vendor* will typically have a large selection of custom configurations (and usually will offer extremely competitive prices), but you must buy your machine sight unseen. *Computer retailers* offer a hands-on environment, but you may pay more than you will if you opt to buy direct. *Superstores* are another source that should offer a wide variety of PCs, but the salespeople may not be PC experts. A *value-added reseller (VAR)* can offer a complete solution, ranging from a custom-built machine to a customized network.

BUYERS' INFORMATION HOT LIST

Company	WARRANTY (YEARS)			
	Parts	Labor	On-site	24-hour, 7 day toll-free tech support
Acer 800-445-6495, www.acer.com	3	3	1	Yes
ALR 800-444-4257, www.alr.com	5	3	1 (\$9.95)	No
Apple 800-776-2333, www.apple.com	1	1	N/A	Yes

Company	WARRANTY (YEARS)			
	Parts	Labor	On-site	24-hour, 7 day toll-free tech support
Hewlett-Packard 800-322-4772, www.hp.com	3	3	1	No
IBM 800-426-2968, www.pc.ibm.com	3	3	1	Yes
Micro Express 800-989-9900, www.microexpress.com	3	3	1	Yes

THE HOME PC



Buying a PC for the home means taking into account your budget, your needs, and the needs of other family members. Once you've done this, you can tailor our basic recommendations below to suit your needs.

1 PROCESSOR SUBSYSTEM A Pentium/166-based system is the bare minimum you should be buying. Pairing the CPU with 256K of cache will boost performance in all your applications.

2 GRAPHICS SUBSYSTEM With a 64-bit graphics card and 2MB of video RAM, you can display up to 64,000 colors at 1,024 by 768 resolution.

BUYERS' WORKSHEET: HOME PC

	OUR RECOMMENDATION	YOUR CHOICE
Price	\$3,000	_____
Processor	166- or 200-MHz Pentium	_____



PC Buyers' Guide

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BUYERS' INFORMATION HOT LIST

WARRANTY (YEARS)

Company	Parts	Labor	On-site	24-hour, 7 day toll-free tech support
Acer 800-445-6495, www.acer.com	3	3	1	Yes
ALR 800-444-4257, www.alr.com	5	3	1 (\$9.95)	No
Apple 800-776-2333, www.apple.com	1	1	N/A	Yes
AST 800-876-4278, www.ast.com	3	3	1	Yes
Austin 800-752-1577, www.austindirect.com	3	3	1	Yes
Compaq 800-345-1518, www.compaq.com	3	3	1	Yes
Dell 800-289-3355, www.us.dell.com	3	1	1	Yes
Digital 800-344-4825, www.windows.digital.com	3	3	1	Yes
DTK 800-289-2385, www.dtk.com	2	2	1 (\$50)	No
Exac				

WARRANTY (YEARS)

Company	Parts	Labor	On-site	24-hour, 7 day toll-free tech support
Hewlett-Packard 800-322-4772, www.hp.com	3	3	1	No
IBM 800-426-2968, www.pc.ibm.com	3	3	1	Yes
Micro Express 800-989-9900, www.wpages.com/microexpress/	2	2	1 (\$50)	Yes
Micron 800-388-6334, www.mei.micron.com	3	1	1	Yes
MidWest Micro 800-728-8582, www.mwmicro.com	3	3	N/A	No
NEC 800-632-4636, www.nec.com	3	3	1	Yes
Packard Bell 800-733-5858, www.packardbell.com	1	1	1	Yes
Sony 800-476-6972, www.sony.com	1	1	1	Yes
Toshiba				

THE HOME PC

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1 PROCESSOR SUBSYSTEM A Pentium/166-based system is the bare minimum you should be buying. Pairing the CPU with 256K of cache will boost performance in all your applications.

2 GRAPHICS SUBSYSTEM With a 64-bit graphics card and 2MB of video RAM, you can display up to 64,000 colors at 1,024-by-768 resolution, which makes Internet surfing look much better. Look also for a card that supports 3-D. Since most 17-inch monitors add only about \$200 to a system's cost, we recommend them.

3 DISK SUBSYSTEM Although 2GB may seem like a lot, Windows 95 and its applications eat up space rapidly.

4 COMMUNICATIONS A 28.8/14.4 data/fax modem is a must if you plan to access the Internet or any online service. If you want to use your PC as a telephony device, make sure you get a voice-capable, full-duplex modem.

5 MULTIMEDIA 8X drives handle virtually all applications very well, many games are still written for the 2X and 4X speeds. A 16-bit sound card with wavetable and FM synthesis will ensure that you get the truest sound possible. A two-piece speaker system should be included with your PC. If you want better sound quality, add-

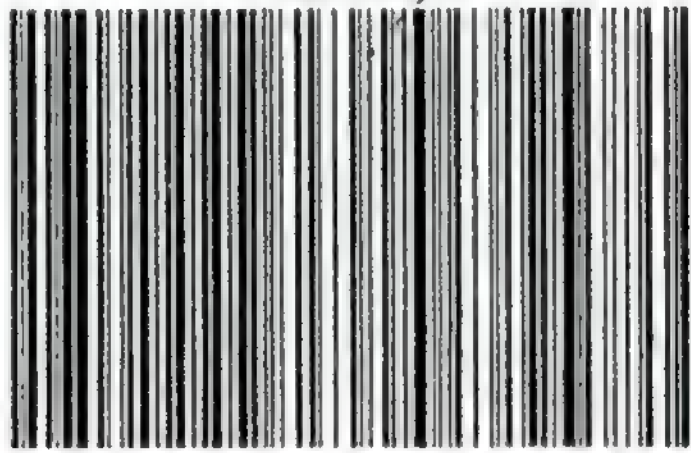
BUYERS' WORKSHEET: HOME PC

	OUR RECOMMENDATION	YOUR CHOICE
Price	\$3,000	
Processor	166- or 200-MHz Pentium	
L2 cache	256K synchronous	
Memory	16MB (minimum)	
Hard disk	2GB EIDE (minimum)	
Monitor	17-inch	
Graphics card	64-bit, with 2MB of graphics memory (minimum)	
MPEG support	Hardware or software (depending on needs)	
CD-ROM drive	8X (minimum)	
Sound	16-bit, with FM and wavetable synthesis	
Speakers	2-piece with subwoofer	
Modem	28.8- or 33.6/14.4-Kbps full-duplex with voice capabilities	
Operating system	Microsoft Windows 95	

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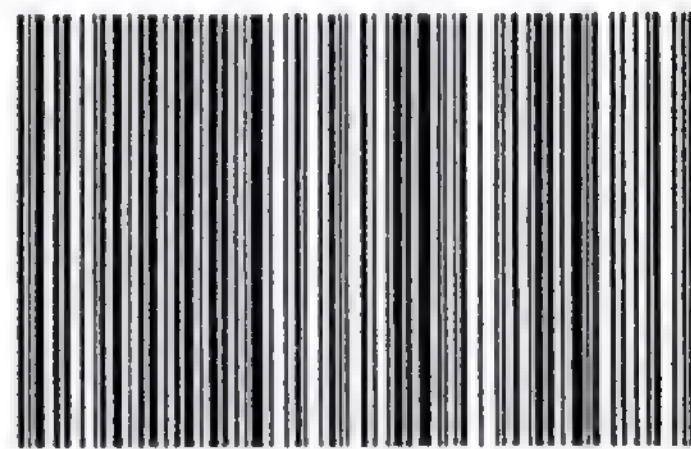
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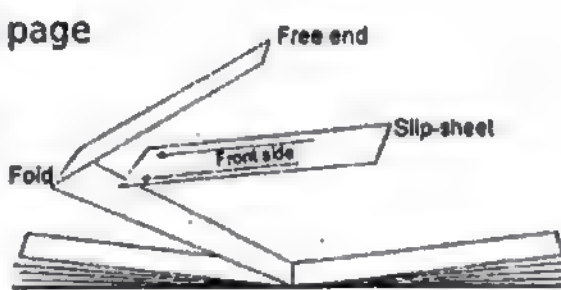
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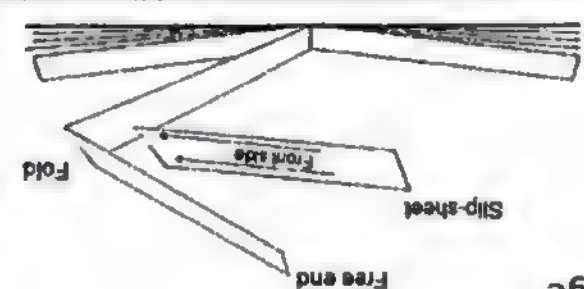


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Foldout slip-sheet



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THE BUSINESS PC



A mainstream business machine is supposed to aid productivity without breaking the bank. The price level for this tightrope-balancing act has hovered at \$3,000 for the past few years.

BUYERS' WORKSHEET: BUSINESS PC

	OUR RECOMMENDATION	YOUR CHOICE
Price	About \$3,000	_____
Processor	166- or 200-MHz Pentium with 256K of L2 cache	_____
L2 cache	256K synchronous	_____
Memory	16MB (minimum)	_____
Hard disk	2GB EIDE	_____
Monitor	15- or 17-inch	_____
Graphics card	64-bit, 2MB of graphics memory	_____
CD-ROM drive	6X (minimum)	_____
Network card	10/100-Mbps PCI Ethernet	_____
Sound	16-bit, with FM synthesis	_____
Speakers	2-piece or integrated	_____
Modem	28.8/14.4-Kbps	_____
Operating system	Microsoft Windows 95	_____

1 MONITOR A 15-inch monitor offers the best value for your corporate dollar, a 17-inch monitor, however, adds only about \$200 to your cost and is easier on the eyes.

2 PROCESSOR A Pentium/166 or Pentium/200 processor is your best bet for great performance at a decent price. As for memory, 16MB of RAM and 256K of external cache is necessary in order to achieve respectable performance.

3 HARD DISK Since the OS and basic business applications take up so much space on your hard disk, a 2GB model is the smallest you should consider.

4 MODEM Look for a voice-capable modem that can take advantage of telephony features.

5 CD-ROM A 6X CD-ROM drive can handle today's business applications without dropping frames or producing video that's out of sync.

6 GRAPHICS MEMORY You will want to display graphics in 64,000 colors, so 2MB of graphics memory is the minimum you should get on your PC's graphics board.

7 SOUND For most office work, a 16-bit sound card (or integrated sound subsystem) with FM synthesis and two speakers is more than adequate.

THE CORPORATE PC

The right corporate workstation can make the difference between getting your work done on time and not getting it done at all—and that's valued more than just what hardware's in the system.



BUYERS' WORKSHEET: CORPORATE WINDOWS NT WORKSTATION

1 PROCESSOR AND MEMORY Pentium Pro 200 prices are extremely attractive. 256K of cache will boost performance. If your OS is Windows NT 4.0, 32MB of RAM is the bare minimum.

2 GRAPHICS SUBSYSTEM If you work with graphics programs, you should have a 128- or 64-bit card with 4MB of RAM.

3 DISK SUBSYSTEM A 3GB SCSI or EIDE hard disk will keep your data moving at the optimum pace. If your applications are especially disk intensive, controller cache will net you a performance gain.

4 NETWORKING AND MANAGEMENT Your PC should support Fast Ethernet either as a PCI add-in card or integrated on the motherboard. Also look for machines that are DMI-compliant, with a MIF browser. Top vendors will also supply client-side software management tools (and drivers for popular NOSs).

5 MULTIMEDIA An 8X CD-ROM drive and 16-bit sound with FM synthesis is fine for most applications. If you work with multimedia development, consider wavetable synthesis and speakers with a subwoofer.

	OUR RECOMMENDATION	YOUR CHOICE
Price	\$4,000 or less	
Processor	200-MHz Pentium Pro with 256K of on-board L2 cache	
Memory	32MB	
Hard disk	3GB SCSI-2 or EIDE (minimum)	
Monitor	17-inch	
Graphics card	128- or 64-bit, 4MB of graphics memory	
Network card	10/100-Mbps PCI Ethernet	
CD-ROM drive	6X (minimum)	
Sound	16-bit, with FM or wavetable synthesis or both	
Speakers	2-piece	
Modem	28.8/14.4-Kbps (optional)	
Operating system	Microsoft Windows NT 4.0	
Software	Client-side network	



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- Tool-free minitower or desktop
- Microsoft Mouse, 104-key keyboard
- Microsoft Windows 95 & MS Plus! CD
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Bus. lease \$163/mo.

- With Intel 166MHz Pentium processor subtract 100

P133

- Intel 133MHz Pentium® processor
- 512KB pipeline burst cache, flash BIOS
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- 12X EIDE CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers
- 28.8 fax/modem, speakerphone, voice mail
- Microsoft® Phone telephony software
- **Internet ready:** Free 1 month Spry™ Internet access; Microsoft Internet Explorer
- Prodigy®, America Online® & CompuServe® trial memberships
- PCI 64-bit 3D video, MPEG, 2MB EDO RAM
- 15" Micron 15FGx, .28dp (13.7" display)
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- Microsoft Mouse, 104-key keyboard
- Microsoft Windows® 95 CD & MS® Plus! CD

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- **Family Pak, including:** ABC by Dr. Seuss; Thinkin' Things™ Collection 1; Earthworm Jim™; and Mechwarrior® 2
- **Microsoft Home Pak, including:** Works 4.0; Publisher Deluxe; Encarta® Encyclopedia; CD Sampler; plus more!

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P200

- Intel 200MHz Pentium processor
- 512KB pipeline burst cache, flash BIOS
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- 12X EIDE CD-ROM drive, 3.5" floppy drive
- 16-bit 3D Wavetable stereo sound card
- Advent AV270 2x25 watt stereo speakers
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- Prodigy, America Online & CompuServe trial memberships
- PCI 64-bit 3D video, MPEG, 2MB EDO RAM
- 17" Micron 17FGx, .26dp (15.8" display)
- **Tool-free** mini-tower or desktop
- Microsoft Mouse, 104-key keyboard
- Microsoft Windows 95 CD & MS Plus! CD
- Microsoft Office Pro 95 & Bookshelf® 95 CDs

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- **Quicken Financial Pak, including:** Quicken Deluxe 5.0; Quicken Financial Planner; Quicken Parents' Guide to Money; and Quicken Family Lawyer
- **Family Pak, including:** ABC by Dr. Seuss; Thinkin' Things Collection 1; Earthworm Jim; and Mechwarrior 2
- **Microsoft Home Pak, including:** Works 4.0; Publisher Deluxe; Encarta Encyclopedia; CD Sampler; plus more!

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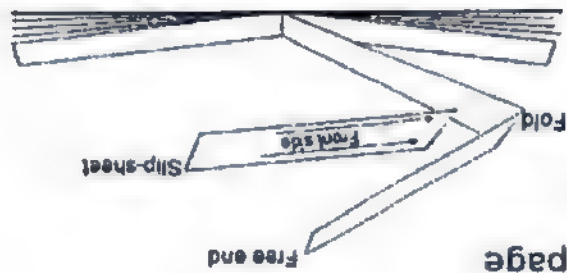


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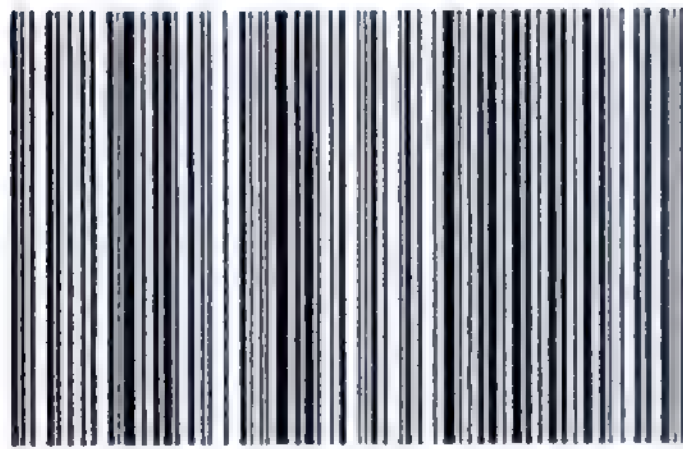


International Fax
208-893-7393



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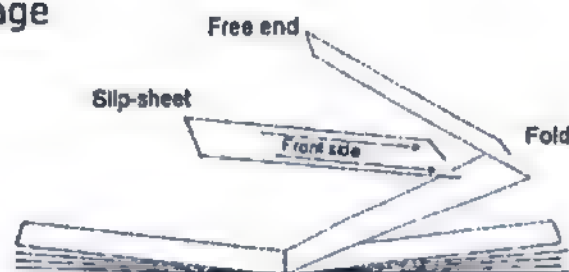


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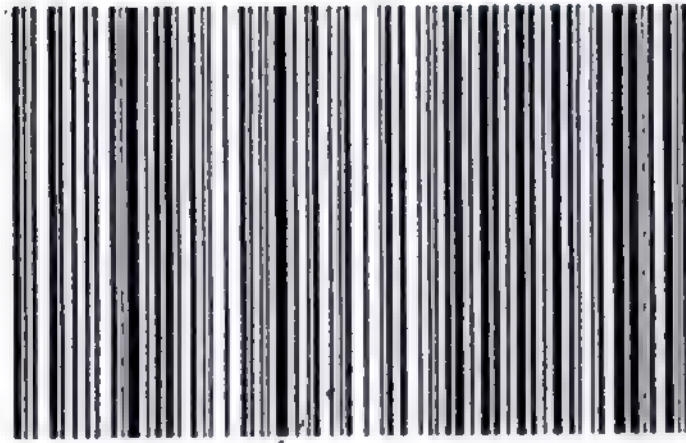
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
 3. Slice the folded edge
 4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



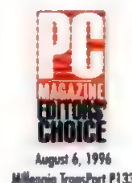
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The warranty is subject to and qualified by Micron's standard limited warranty and terms and conditions of sale. Terms and conditions of sale may vary by specific configurations. Copies of the Micron warranty may be obtained on our Web site or by calling Micron.

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Stealth 3D 2000 graphics card. The system also features a 15-inch monitor.

With a host of top-notch components, the XLP200 delivered some higher test results than its sibling. Its 12X Mitsumi CD-ROM drive helped it post this roundup's highest CD-ROM WinMark 97 score. The unit's Disk WinMark 97 score was also above average, thanks to a 2GB Fast/Wide SCSI-2 hard disk. The DMI-compliant XLP200 has a 17-inch monitor and a soft power-down feature.

Each Energy Star-compliant EPS PC includes Microsoft Office for Windows 95 and a 28.8/14.4-Kbps modem (33.6/14.4-Kbps modems will be standard by the time you read this) that offers voice mail and full-duplex speakerphone capabilities.

A great price and good performance make the LP200 a strong contender for value-oriented buyers; those needing more power and performance should find what they seek in the XLP200.—CM

Gateway 2000 Inc. **P5-200 FPC**

The \$3,437 (direct) Gateway P5-200 FPC—short for “family PC”—is a multimedia system aimed at home-office and small-business users. This solid performer ships with a large set of multimedia components, including a Panasonic CD-Recordable drive, as well as a hefty software bundle that includes edutainment and productivity titles.

The FPC's tower houses an Intel motherboard with synchronous DIMM-form-factor DRAM. The unit also has a soft power-down feature, and both the system and its Sony 17-inch monitor are Energy Star-compliant. With its 8X Toshiba CD-ROM drive, the FPC managed an above-average CD-ROM WinMark 97 score; the rest of its test results were average. High-quality sound is provided by two Altec ACS40 speakers with subwoofer and a 16-bit Ensoniq wavetable sound card.

The FCS sets itself apart with a Telepath 28.8V modem with telephony features, a Panasonic CD-Recordable drive, and a Gravis gamepad. The modem offers voice mail and full-duplex speakerphone functions, while the CD-R reads disks at 4X speeds and writes at 2X. Gateway also includes its Ultimate Soft-

ware Pack (including games and other home titles) and Microsoft Office Professional Edition for Windows 95.

The P5-200 FPC continues Gateway's tradition of providing PCs with lots of bang for the buck.—CM

Hewlett-Packard Co. **Vectra VL 5/200 MT Series 4**

The Vectra VL 5/200 MT Series 4 (\$2,840 street), a competitive performer on our tests, is a reasonable choice for its target audience of value-conscious corporate buyers. Although our test unit included a 4X CD-ROM drive and a 1.5GB hard disk, an 8X CD and 2.5GB disk will be standard equipment by the time you read this (for a higher price: \$3,510 street). HP also ships a Vectra X-line for networked corporate workgroups, and Vectra Model 500s for small businesses.

All Vectra PCs now have HP's unique Start Key feature, which allows users to turn on the PC from the keyboard. When the system is off, hitting the spacebar is akin to pressing the power button. HP also provides a tool-free chassis and a soft power-down feature.

Based on an HP motherboard, the Vectra VL produced average scores on all but one of our tests. Because of a 4X Hitachi CD-ROM drive, this mini-tower's CD-ROM WinMark 97 score was the lowest of the group. The Vectra VL has a single internal speaker, but HP includes two standalone Labtec speakers with VL Series 4 PCs. Sound originates from a Creative Labs sound card that supports FM synthesis. This PC also came with a 17-inch HP monitor.

The upgrades HP has made and some of the unit's features, such as the Start Key feature, make it a system to consider.—CM

Hymco Technologies Inc. **User-200**

Systems from Hymco Technologies—including the User-200 (\$2,500 direct)—are meant to be standalone desktops for business and home-office environments. The bargain-priced User-200 enhances its appeal with respectable performance and a good set of components.

The User-200 turned in average scores on each of our



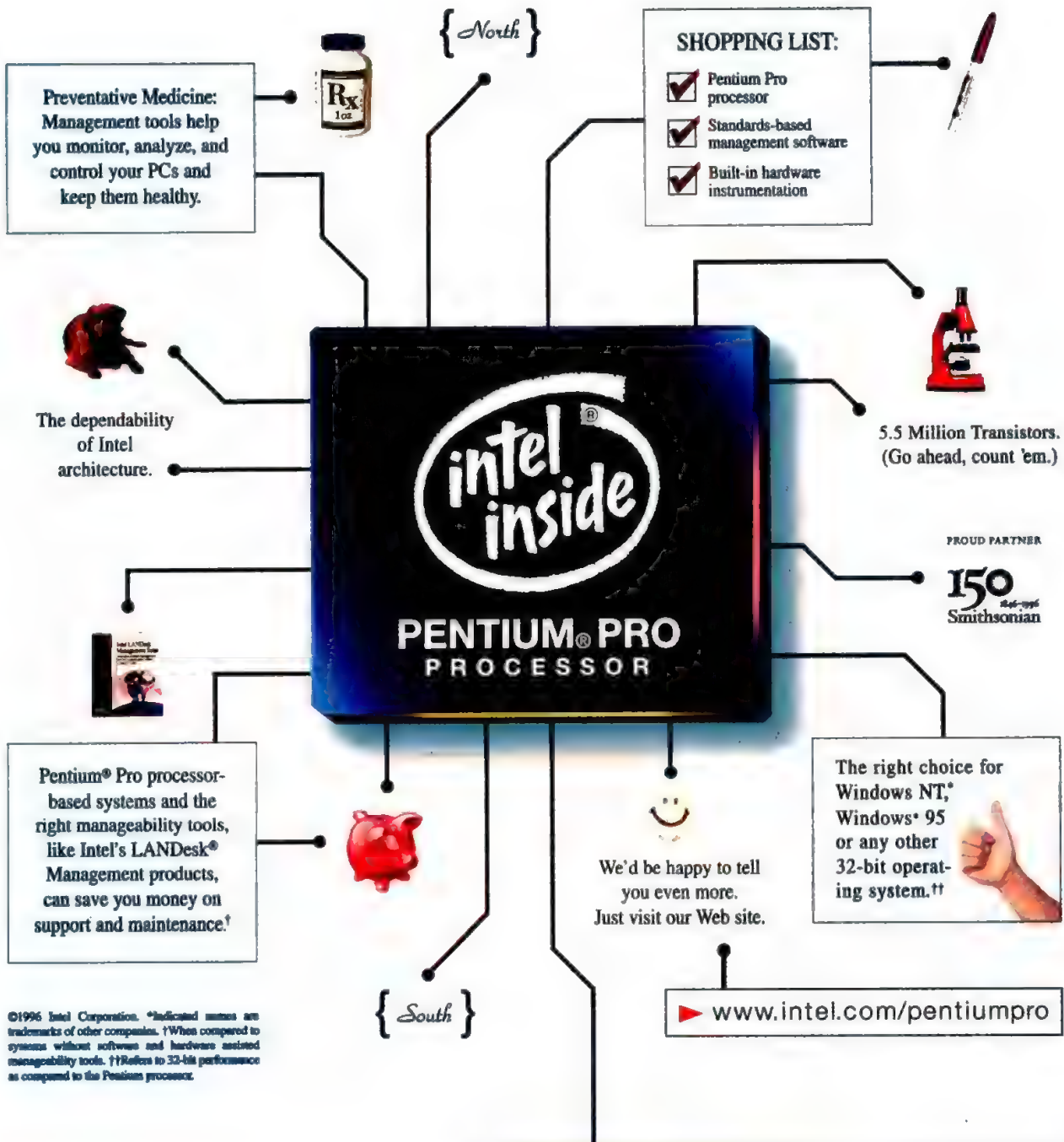
P5-200 FPC. Direct price: \$3,437. Gateway 2000 Inc., North Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023; www.gw2k.com. Circle 457 on reader service card.



Vectra VL 5/200 MT Series 4. Street price: \$2,840. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900; fax, 800-333-1917; www.hp.com. Circle 458 on reader service card.



IBM PC 350. Street price: \$3,870. IBM Personal Computer Co., Armonk, NY; 800-426-4968; fax, 800-426-4329; www.pc.ibm.com. Circle 460 on reader service card.



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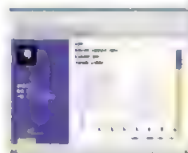
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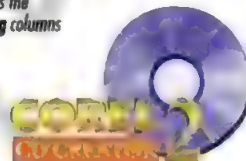
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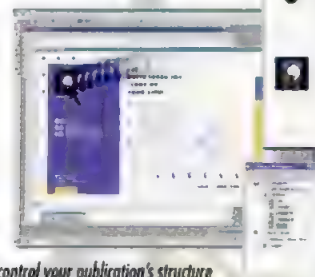
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tests—save for CD-ROM WinMark 97 and Disk WinMark 97, which were below average. Its 6X Toshiba drive couldn't compete with this roundup's army of 8X drives; and its 1.5GB EIDE hard disk fell behind a field of faster disks. The rest of the system's core components are adept: an Intel motherboard, the 430HX chip set, 256K of pipelined-burst L2 cache, and a Matrox MGA Millennium graphics card.

This roomy midtower is Energy Star- and DMI-compliant, and includes a soft power-down feature. Sound is provided by an integrated Yamaha chip set (with support for both wavetable and FM synthesis) and two enormous Pro JUSTer SP690 speakers. The unit also came with a 17-inch monitor that supports both DDC1 and DDC2.

A good price enhances the appeal of this mostly average performer. —CM

User-200. Direct price: \$2,500. Hymco Technologies Inc., San Jose, CA; 800-884-9626, 408-251-6888; fax, 408-251-2333; www.hymco.com. *Circle 459 on reader service card.*

IBM Personal Computer Co. **IBM PC 350**



IBM's PC 350 (\$3,870 street), an Editors' Choice in this roundup, is targeted at corporate PC users who want the latest technology and the best performance at a reasonable price. The PC 350 will ably meet the needs of this audience: It was a competitive performer in this fast group and comes with a full set of high-end components, including a 3GB hard disk, two USB ports, and top-quality speakers, as well as IBM's NetFinity client software to manage the PC 350 over the network.

The PC 350 will fit well into a networked corporate environment: It's DMI-compliant and includes a MIF browser. With the bundled copy of IBM's NetFinity client software, network administrators can easily manage this PC over the network. Also supported is IBM's Wake-On-LAN technology (a Wake-On-LAN adapter, which supports both Token Ring and Ethernet, is a \$120 option); it is used to wake up the PC 350 from across the LAN. The PC 350 also comes with IBM EasyTools, CoSession, Proshare Premier videoconferencing software, Puma's TranXit for IR transfers, and Lotus SmartSuite 96.

The PC 350 uses an IBM motherboard with Intel's 430HX chip set and 512K of L2 cache. The unit's test scores were on a par with those of its competition.

If network readiness is important to you, you'll get more than your money's worth from IBM's PC 350. —BB

Mega Computer Systems **Impact Pentium200+**

The \$2,950 (street) Impact Pentium200+, from Mega Computer Systems, boasts high-end components and impressive test scores, making it a good choice for a corporate environment.

The Impact Pentium200+ used high-end components to garner average to above-average test scores. With EDO memory and 512K of L2 cache, the unit earned average scores on our CPUmark tests. The system was one of eight to use the

Number Nine Imagine 128 Series II graphics card, which helped it tie for first place on the Graphics WinMark 97 test. A 2GB Fast/Wide SCSI-2 hard disk boosted the system to an above-average score on our Disk WinMark 97 test; its Winstone 97 score was average. An 8X Toshiba CD-ROM drive helped it achieve an above-average CD-ROM WinMark 97 score.

The midsize tower case also houses a 33.6/14.4-Kbps Archtek modem, a USB port, and an integrated Creative Labs Vibra 16 sound adapter. A Microsoft Natural keyboard and a 15-inch MGC monitor complete the hardware package.

A good price and great performance make the Impact Pentium200+ a serious contender for business buyers. —Richard S. Shim

Impact Pentium200+. Street price: \$2,950. Mega Computer Systems, San Diego; 800-338-6628, 619-487-8888; fax, 619-485-1518; www.megacs.com. *Circle 461 on reader service card.*

Micro Express **MicroFlex-PCI/200, MicroFlex-686/P200+**

The \$3,419 MicroFlex-PCI/200 is powered by an Intel 200-MHz Pentium chip, while the \$2,899 MicroFlex-686/P200+ has a Cyrix 6x86-P200+ CPU. These excellent performers—the Cyrix-based unit was our Winstone champion in this roundup, while the Pentium-based unit was second—target power business users and corporate workstation applications.

The Cyrix-based unit used a DFI Screamer Pro motherboard with the VLSI Lynx chip set, while its Pentium counterpart had a Micro Express motherboard with Intel's 430VX chip set. Both came with Microsoft Natural keyboards.

Except for the motherboard and CPU differences, the two systems were identically equipped. The units' CMD caching disk controllers with 16MB of RAM and 2GB Fast/Wide SCSI-2 hard disks were undoubtedly a factor in their attaining top Winstone 97 and Disk WinMark 97 scores.

Whether you opt for Intel or Cyrix, you'll get the job done fast with one of these PCs—all without breaking the bank. —Bruce Brown

MicroFlex-PCI/200. Direct price: \$3,419. **MicroFlex-686/P200+.** Direct price: \$2,899. Micro Express, Irvine, CA; 800-989-9900, 714-852-1400; fax, 714-852-1225; www.wpages.com/microexpress. *Circle 462 on reader service card.*

Micron Electronics Inc. **Millennia, Millennia Plus**

Micron Electronics continues to offer well-priced, adept PCs, as both the \$2,507 Millennia and the \$3,248 Millennia Plus testify. While the Millennia is aimed at midrange business users, the Millennia Plus targets corporate power users. Both offer impressive graphics and healthy software bundles.

On the cutting edge as usual, Micron equips each of these machines with a Diamond Multimedia Stealth 3D 2000 graphics card. This card supports 3-D rendering and led both systems to above-average Graphics WinMark 97 scores: The Millennia Plus's score on this test was one of the highest in the roundup. Other test results were markedly average for both systems.

Micron makes sure that both of these Energy Star-compliant units have a convenient soft power-down feature and a tool-free mini-tower chassis. A copy of Microsoft Office Pro 95 is also included.

Great graphics performance and solid test results distinguish these two Micron PCs, which should meet all of your needs, whether you require an everyday workhorse or a computing powerhouse.—*CM*

Millennia. Direct price: \$2,507. **Millennia Plus.** Direct price: \$3,248. Micron Electronics Inc., Nampa, ID; 800-388-6334, 208-893-3434; fax, 208-893-3424; www.mei.micron.com. *Circle 463 on reader service card.*

MidWest Micro P5-200 Office PC

MidWest Micro's \$2,662 (direct) P5-200 Office PC is targeted at both corporate and small-office/home-office users. A mostly average performer with several high-powered components, the MidWest Micro system is a good buy. The company also offers the Office Pro and 3D Interactive MPEG lines.

The P5-200 uses an ASUSTek motherboard with 512K of L2 cache and very fast 12-ns SDRAM. The unit's CPUmark results were average, however. The Disk WinMark 97 score was below average, partly because of the slow 4,500-rpm 2.4GB Quantum hard disk. Graphics performance was on the high side of average thanks to the P5-200 Office PC's Number Nine Imagine 128 Series II graphics card.

MidWest Micro uses an 8X Acer CD-ROM drive and a Sound Blaster 32 audio card. The bundled speakers are Altec Lansing ACS31 models with a subwoofer. A 15-inch Infotel monitor comes standard with the unit. An Infotel 28.8/14.4-Kbps data/fax modem with voice mail and caller ID is also included.

In addition to Windows 95, the P5-200 Office PC is bundled with Microsoft Plus Pack, Microsoft Office Professional 95, Microsoft Encarta 96, and Microsoft Bookshelf.

A good software bundle and speakers but mostly average performance mark this machine. Those with disk-intensive applications might want to get a faster hard disk.—*BB*

MitAC Computers Inc. Professional 430H, Pursuit 430V

MitAC Computers' Pursuit 430V (\$2,000 street) is targeted at the entry-level networked desktop user. The Professional 430H (\$3,000 street) is intended for workstation network applications and those who demand higher performance. Both come with Fast Ethernet cards and scored in the average range on our tests except for each unit's above-average score on the CD-ROM WinMark 97 test. The Professional outgunned the Pursuit model on every test, however.

Each unit features 512K of L2 cache, and each has a sleep switch on the front of its case that puts the system into low-power mode. The two systems came with different hard disks and motherboards: The Pursuit used a MitAC motherboard and a 2GB Fast-ATA 2 disk, while the Professional came with an ASUSTek motherboard and a 2GB Fast/Wide SCSI-2 disk. The Professional also had a 17-inch monitor; the Pursuit's was a 15-inch model, but the unit boasts two USB ports and an IrDA infrared sensor.

These network-ready machines are both appealing, each offering what you need right out of the box.—*BB*

Professional 430H. Street price: \$3,000. **Pursuit 430V.** Street price: \$2,000. MitAC Computers Inc., Fremont, CA; 800-756-3888, 510-656-3333; fax, 510-440-3604; *Circle 465 on reader service card.*

Mitsuba Corp. Premier System-200

Mitsuba Corp. targets the \$2,100 (street) Premier System-200 as a corporate workstation for general-purpose business computing. With benchmark scores typically within the average range, Mitsuba's positioning is just about right, providing very reasonable performance at an attractive price. Mitsuba is largely a custom-series house: The company makes one basic PC line that can be configured differently for specific end-user needs.

The Mitsuba motherboard in this unit carries Intel's 430VX chip set, 512K of L2 cache, and extremely fast 10-ns SDRAM. The installed Seagate Fast ATA-2 5,400-rpm hard disk contributed noticeably to the Premier System-200's average Disk



P5-200 Office PC. Direct price: \$2,662. MidWest Micro, Fletcher, OH; 800-728-8582; 513-368-2309; fax, 513-368-2306; www.mwmicro.com. *Circle 464 on reader service card.*

Premier System-200. Street price: \$2,100. Mitsuba Corp., La Verne, CA; 800-648-7822, 909-392-2000; fax, 909-392-2021; www.mitsuba.com. *Circle 466 on reader service card.*

PowerMate P2200. Street price: \$2,900. NEC Computer Systems, Boxborough, MA; 800-632-4636, 508-264-8000; fax, 800-366-0476; www.nec.com. *Circle 467 on reader service card.*

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WinMark 97 score; other scores were also average.

The Premier System-200 is equipped with an STB Light-speed 128 graphics card with 2MB of MDRAM and a 15-inch Hyundai monitor. Multimedia components include an 8X Sony CD-ROM drive, a Sound Blaster 32 audio card, and JUSTer speakers. The JUSTer SP-980 speakers are great for office parties—they hold steady at loud volumes, without breaking up and distorting bass signals.

A bargain price, a good component set, and solidly average performance make this general business system worthy of a second look.—BB

NEC Computer Systems **PowerMate P2200**

NEC Computer Systems' DMI-enabled PowerMate P2200 (\$2,900 street) is an attractive buy for the corporate set, with integrated Fast Ethernet support, as well as the vendor's Client-Manager software suite, which provides system security and monitoring capabilities. NEC markets the unit as an upper-level performance machine.

The system is based on an Intel motherboard built to NEC's specifications. Two integrated components stand out: a Fast Ethernet adapter and an ATI GT Rage graphics chip set with 2MB of SGRAM. This chip set contributed to a below-average Graphics WinMark 97 score, however, although the machine's other test scores were average.

McAfee's VirusScan and WebScan protect the unit from viruses, but if a virus somehow attacks your system, CyberMedia's FirstAid 95 Deluxe fixes software errors and alerts the user before the system crashes. Hardware monitoring is covered by the on-board MagicEye chip set, which alerts the IS manager when the chassis is opened. Remote notification is available via pager or cellular phone using Intel's LAN-Desk ClientManager. This system is also DMI-enabled and includes a MIF browser that monitors more than 170 system attributes.

Average performance and built-in networking hardware and software make the PowerMate P2200 an attractive buy for corporate users.—RSS

Polywell Computers Inc. **Poly 5200IP5, Poly 686-200CX**

Polywell Computers' \$2,800 (direct) Poly 686-200CX and \$3,238 (direct) Poly 5200IP5 cover two ends of the corporate market. The Cyrix 6x86-based 686-200CX is targeted at price-conscious users who want good performance. For power users who want high-end components and dual-processing capability, Polywell offers the Pentium-based 5200IP5.

The two units use many of the same components, with the exception of the motherboard. The 686-200CX uses the VLSI-based DFI motherboard, while the 5200IP5 has a Tyan motherboard with the Intel 430HX chip set. The 5200IP5 also has a 17-inch monitor; its sibling's is a 15-inch model. Test results were average except for both units' above-average Disk WinMark 97 scores and the 5200IP5's above-average CD-ROM WinMark score.

You'll get the job done with either of these Polywell ma-

chines, although the Cyrix unit may be a better value, since it offers most of the same components and performance as its pricier sibling.—RSS

Poly 5200IP5. Direct price: \$3,238. **Poly 686-200CX.** Direct price: \$2,800. Polywell Computers Inc., South San Francisco, CA; 800-999-1278, 415-583-7222; fax, 415-583-1974; www.polywell.com. Circle 468 on reader service card.

ProGen Systems **DiscoverMPEG II P200**

You get a lot for the money with ProGen Systems' ProGen DiscoverMPEG II P200 (\$2,499 direct): a high-quality Panasonic Pro P17 monitor, a Matrox MGA Millennium graphics card, and competitive performance. The unit is targeted as a general-purpose corporate multimedia system.

Our test unit's midtower case housed a ProGen motherboard with Intel's 430HX chip set and 512K of L2 cache. The unit's 2GB 5,200-rpm EIDE hard disk helped it to an average Disk WinMark 97 score. Other benchmark test scores were also average, except for the CD-ROM WinMark 97 score, which was above average.

The machine came with a 33.6/14.4-Kbps data/fax modem with distinctive ring and Caller ID support. It also had an 8X CD-ROM drive, a Sound Blaster 32 audio card, and low-quality MIDI Land MLI-D2 speakers. In addition, ProGen bundles such programs as American Heritage Talking Dictionary and Zoo Explorer with the system, which reflect the PC's multimedia capabilities more than its business-oriented potential.

This ProGen unit packs a lot for the price, offering a good set of components and competitive performance.—BB

DiscoverMPEG II P200. Direct price: \$2,499. ProGen Systems, Tustin, CA; 800-848-1353, 714-566-9200; fax, 714-566-9267; www.progen.com. Circle 469 on reader service card.

Quantex Microsystems **QP5/200 SM-2**

Good components strengthen this average performer from Quantex Microsystems. The QP5/200 SM-2 (\$2,999 direct) is a general-purpose corporate and SOHO system, intended for professionals who need powerful performance and good multimedia capabilities.

The midtower system uses a Nexis Microsystems motherboard with Intel's 430HX chip set and 512K of L2 cache. The unit's other components include an Ensoniq Soundscape VI-VO audio card and ear-pleasing Altec Lansing ACS-400 speakers and subwoofer. The system also came with a 33.6/14.4-Kbps data/fax modem with voice mail, and a 17-inch MAG monitor.

The QP5/200 had mostly average test scores. The only exception was a below-average CD-ROM WinMark 97 score, a result of its 8X Toshiba CD-ROM drive.

Quantex sent a full bundle of software with this system, with such titles as Corel WordPerfect Suite, Quicken SE, and Compton's Interactive Encyclopedia and Reference Collection. Microsoft Plus! is also included with Microsoft Windows 95.

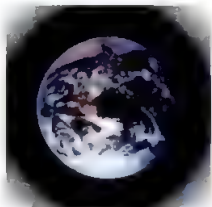
The Vision

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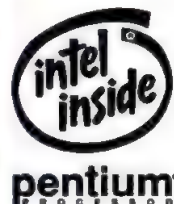
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16-Bit Stereo Business Audio, Built-in
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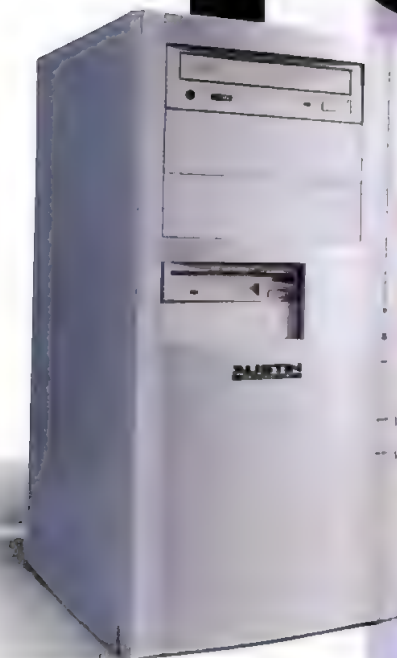
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128-Bit PCI Video Accelerator - 2MB MRAM
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15" 28mm NT VGA Monitor
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Austin PowerPLUS 133

133 MHz Intel Pentium Processor (also available in 100-, 120-, 150-, 166-, or 200-MHz configurations)
Intel 430HX PCI Set
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16MB EDO RAM (expandable to 128MB)
256KB L2 Pipeline Burst Cache
1.6GB Enhanced IDE Hard Drive
64-Bit PCI Video Accelerator - 2MB EDO DRAM
12X IDE CD-ROM Drive, 16-Bit Audio,
40W Stereo Speakers
33.6K Data/Fax/Voice Modem
15" 28mm NT VGA Monitor
104-Key Keyboard & Mouse
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Windows 95 Pre-Installed
Three-Year Parts & Labor Warranty,
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"Austin's Affinity XPro"

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— PC Magazine, October 22, 1996

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SUMMARY OF FEATURES

Pentium and Cyrix PCs

■ YES ■ NO	Aberdeen PS-200SE	AcerPower Pentium 200MHz	ACMA zPower 200	ACT PS-200CD	AMAX Power Station GFX-5200	AST Bravo MS-T 5200	Austin PowerPlus 200
Products listed in review order							
Price of tested configuration	\$2,595 (direct)	\$2,700 (street)	\$3,695 (direct)	\$3,698 (direct)	\$3,499 (direct)	\$2,520 (street)	\$2,699 (direct)
Processor	Pentium/200	Pentium/200	Pentium/200	Pentium/200	Pentium/200	Pentium/200	Pentium/200
Installed RAM	16MB EDO	16MB EDO	16MB SDRAM	16MB EDO	16MB SDRAM	16MB EDO	16MB EDO
Hard disk	Seagate Medalist ST32140A	Seagate Medalist ST32140A	Seagate Medalist ST32140A	Seagate Hawk ST32155W	Quantum Atlas XP32150W	Maxtor 72004AP	Western Digital Caviar AC32100
Capacity and interface	2GB Fast ATA-2	2GB Fast ATA-2	2GB Fast ATA-2	2GB Ultra SCSI	2GB Fast/Wide SCSI-2	1.9GB EIDE	2GB EIDE
Graphics adapter	STB Lightspeed 128	Diamond Stealth3D 2000	Matrox MGA Millennium	Number Nine Imagine128 Series II	STB Lightspeed 128	Integrated ATI Mach64 VT	STB Lightspeed 128
Memory	2.3MB MDRAM	2MB DRAM	4MB WRAM	4MB VRAM	2.3MB MDRAM	2MB SDRAM	2MB MDRAM
Monitor (and screen diagonal claimed/measured, in inches)	KDS VSX-7 (17,15.5)	Acer 56e (15,13.5)	ADI MicroScan 5V (17,16)	MAG InnoVision DX1595 (15,14)	MAG InnoVision DX1795E (17,16)	AST Vision 5L (15,14)	CTX 1785D (17,16)
CD-ROM drive (speed)	Toshiba XM-5602B (8X)	Acer 685A (8X)	Toshiba XM-5602B (8X)	Nakamichi MJ-4.8si (8X)	Plextor Px83CS (8X)	Torisan CDR-S16 (4X)	Sony CDU311 (8X)
Sound adapter	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster 16	Creative Labs Vibra 16S	CrystalLake 200 Series Wavetable Card
Speakers	Integrated	QuickShot SoundForce 550	Altec Lansing ACS51	MIDI Land MLI-95	Kingtex EP-280	Labtec LCS-1025	Micro Innovations Pro Series MM40P
Modem speed (data/fax, in Kbps)	33.6/14.4	N/A	28.8/14.4	33.6/14.4	33.6/14.4	N/A	28.8/14.4
Network adapter	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Motherboard Components							
Installed external RAM cache and type	512K pipelined- burst	256K pipelined- burst	256K pipelined- burst	512K pipelined- burst	512K synchronous	256K pipelined- burst	256K pipelined- burst
Motherboard manufacturer	SuperMicro	Acer	Tyan	SuperMicro	Impression	Intel	Intel
Chip set	Intel 82430HX	Intel 82430HX	Intel 82430VX	Intel 82430HX	Intel 82430VX	Intel 82430HX	Intel 82430HX
Expandability							
Maximum RAM	768MB	192MB	128MB	768MB	128MB	192MB	128MB
Expansion-bus slots	4 ISA, 4 PCI	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI	4 ISA, 3 PCI	4 ISA, 1 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA
Bays: accessible (5.25", 3.5")/internal (5.25", 3.5")	3, 2, 0, 2	3, 2, 0, 2	6, 1, 0, 3	3, 2, 0, 3	5, 2, 1, 1	3, 1, 0, 3	2, 3, 0, 2
Parallel/serial/mouse ports	0, 3, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1
Service and Support							
7-day, 24-hour live technical support	■	■	■	■	■	■	■
Standard warranty on parts/labor	1 year/1 year	3 years/3 years	3 years/1 year	1 year/1 year	3 years/1 year	3 years/3 years	3 years/3 years
On-site service charge	\$119.95 (1 year)	Included (1 year)	Included (1 year)	\$129.95 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)
N/A—Not applicable; The product does not have this feature.							

A good software bundle and some better-than-average components highlight this average performer.—BB

QP5/200 SM-2. Direct price: \$2,999. Quantex Microsystems, Somerset, NJ; 800-760-9001, 908-563-4166; fax, 908-563-0407; www.quantex.com. Circle 470 on reader service card.

Reason Technology Inc. Square 5 HO/HX, Square 5 HX/MA

Reason Technology's Square 5 HO/HX (\$2,695 direct) is a dual-processor system that is meant for demanding applications, while the company's Square 5 HX/MA (\$2,495 direct), a single-processor PC, is a general-purpose corporate machine.

On all of our benchmark tests, the HO/HX outscored the HX/MA, and the performance differences can be traced to components they don't have in common. Where the HX/MA

had 256K of L2 cache and a 4,500-rpm 2.4GB hard disk, the HO/HX had 512K of L2 cache and a 7,200-rpm 2.2GB Fast/Wide SCSI-2 hard disk. The HO/HX's larger cache boosted its CPUmark scores, which led to an above-average Disk WinMark 97 score and affected all its other scores. The HX/MA's CPUmark score was below average. Other scores were mostly average for both units; exceptions include above-average CD-ROM WinMark 97 results for both units and an above-average Graphics WinMark 97 score for the HO/HX.

Each of the Square units has a 17-inch monitor, but the HX/MA's is a Nokia model with integrated speakers. The HO/HX comes equipped with a Samsung monitor and Yamaha YST-M5 speakers.

Appealing prices mark both of these systems, but the HO/HX's better components and stronger test results make it well worth the extra \$200.—BB

PCs
Pentium and Cyrix PCs

Continues

PC MAGAZINE
EDITORS' CHOICE

Compaq Premio HX-P200	Comrade Multimedia Wide-SCSI Powerstation HX	CyberMax Max H-P200	CyberMax ProMax 7 P200+	Cyrix 6x86-P200	Dell Dimension XPS P200+	DFI Landmark VPS Plus	DirectWave P200 MVP ProLS	DTK Coin- 55M/P200	EPS XLP200
\$3,300 (street)	\$3,095 (direct)	\$2,449 (direct)	\$2,399 (direct)	\$2,699 (direct)	\$3,179 (direct)	\$2,900 (street)	\$2,979 (direct)	\$2,650 (street)	\$3,595 (direct)
Pentium/200	Pentium/200	Pentium/200	Cyrix 6x86-P200+	Cyrix 6x86-P200+	Pentium/200	Cyrix 6x86-P200+	Pentium/200	Pentium/200	Pentium/200
16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB SDRAM	16MB EDO	16MB EDO	16MB EDO	16MB EDO
Quantum Atlas XP32150W	Quantum Atlas XP32150W	IBM Deskstar DAQA-33240	IBM Deskstar DAQA-33240	Western Digital Caviar AC32500	IBM Deskstar DAQA-33240	Quantum Sirocco 1700AT	Quantum Atlas XP32150W	Quantum Fireball 3200AT	Quantum Atlas XP32150W
2GB Fast/Wide SCSI-2	2GB Fast/Wide SCSI-2	3GB ATA-3	3GB ATA-3	2.4GB EIDE	3GB ATA-3	1.6GB Fast ATA-2	2GB Fast/Wide SCSI-2	1.5GB Fast ATA-2	2GB Fast/Wide SCSI-2
Number Nine Imagine 128	Diamond Stealth3D 2000	STB Lightspeed 128	VideoLogic GrafixStar 600	Matrox MGA Millennium	Number Nine Imagine 128 Series II	Matrox MGA Millennium	STB Lightspeed 128	STB Lightspeed 128	Diamond Stealth64 Video VRAM 3240
4MB VRAM	2MB DRAM	2MB MDRAM	2MB MDRAM	2MB WRAM	4MB VRAM	2MB WRAM	2MB MDRAM	2MB MDRAM	2MB VRAM
Sceptor PN- P514DA (17,15.5)	Princeton Ultra 17+ (17,15.8)	Princeton Ultra 17+ (17,15.8)	Princeton Ultra 17+ (17,15.8)	MAG InnoVision DX1795 (17,16.3)	Dell UltraScan 17LS (17,15.8)	Esprit Systems CX-4158 (15,13.8)	MAG InnoVision DX1795 (17,16.3)	ADI MicroScan 5V (17,15.8)	CTX 1785XA (17,16.3)
Acer 695A (8X)	Goldstar GCD-R580B (8X)	Toshiba XM-5602B (8X)	Toshiba XM-5602B (8X)	Mitsumi CRM- FX810T (8X)	Sony CDU311 (8X)	Mitsumi CRM- FX810T (8X)	Toshiba XM-5602B (8X)	Sony CDU311 (8X)	Mitsumi CRM- FX120T (12X)
ESS 290E	Aztec MM Waverider	Ensoniq SoundscapeVIVO	Ensoniq SoundscapeVIVO	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster AWE32 Upgrade	DFI SC-200	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster 16	Ensoniq SoundscapeVIVO
MIDI Land MLI-130	Premier OX-S12	Alttec Lansing ACS5	Alttec Lansing ACS5	Labtec LCS-2612	Alttec Lansing ACS31	MIDI Land MLI-691H	Macase SK-A30	Lansonic TV-170	Labtec LCS-3210
N/A	33.6/14.4	28.8/14.4	28.8/14.4	N/A	28.8/14.4	N/A	33.6/14.4	N/A	28.8/14.4
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Intel Ether- Express PRO/100
512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	256K pipelined- burst	256K pipelined- burst	512K pipelined- burst	256K pipelined- burst	512K pipelined- burst	256K pipelined- burst	256K pipelined- burst
Microstar	Tyan	Biostar	DFI	DFI	Intel	DFI	ASUSTek	DTK	BCM
Intel 82430HX	Intel 82430HX	Intel 82430VX	VLSI VL82C54x	VLSI VL82C54x	Intel 82430VX	VLSI VL82C53	Intel 82430HX	Intel 82430HX	Intel 82430HX
512MB	512MB	128MB	128MB	256MB	128MB	256MB	256MB	128MB	256MB
3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA
3, 2, 0, 1 1, 2, 1	3, 2, 0, 2 1, 2, 1	4, 1, 0, 3 1, 1, 1	3, 1, 0, 2 1, 2, 1	3, 1, 0, 3 1, 2, 1	2, 3, 0, 2 1, 1, 1	3, 2, 0, 2 1, 2, 1	3, 2, 0, 2 1, 2, 0	3, 1, 0, 3 1, 2, 1	2, 3, 0, 2 1, 2, 1
3 years/2 years \$75.00 (1 year)	1 year/1 year Included (1 year)	1 year/1 year Included (1 year)	1 year/1 year Included (1 year)	3 years/3 years Included (1 year)	3 years/1 year Included (1 year)	2 years/lifetime Included (1 year)	3 years/3 years Included (1 year)	2 years/2 years \$50.00 (1 year)	3 years/1 year Included (1 year)

Square 5 HO/HX. Direct price: \$2,695. **Square 5 HX/MA.** Direct price: \$2,495. Reason Technology Inc., Minneapolis; 800-800-4860, 612-780-4792; fax, 612-780-4797; www.reasontech.com. **Circle 471 on reader service card.**

Robotech Inc. **Cobra XLT 200**

The Cobra XLT 200 (2,699 direct) is one of Robotech's business systems, configured for general corporate and SOHO applications and as an entry-level graphics workstation. The unit wasn't one of this roundup's leading performers, but it comes with a broader-than-average complement of peripherals, including a network card.

The Cobra XLT 200 has a Robotech motherboard with Intel's 430HX chip set and 256K of L2 cache. Its 5,200-rpm, 2.4GB EIDE hard disk couldn't match others spinning at 5,400

rpm or faster and kept the unit's Disk WinMark 97 score below average. The system's Number Nine Imagine 128 Series II graphics board helped it earn average scores on the Graphics WinMark 97 and Winstone 97 benchmark test programs.

The unit also comes with an NDC OpenEthernet 4100 Fast Ethernet adapter. Other components include a Creative Labs Sound Blaster 16 audio card, a 17-inch monitor, and a 33.6/14.4-Kbps data/fax modem. Microsoft Office Professional 95 is bundled.

If you don't need blazing disk performance, the Cobra XLT 200's all-encompassing hardware bundle and generous warranty make it a strong contender.—BB

Cobra XLT 200. Direct price: \$2,699. Robotech Inc., Midvale, UT; 800-255-2215, 801-565-0645; fax, 801-565-0680; www.robotechusa.com. **Circle 472 on reader service card.**

SUMMARY OF FEATURES

Pentium and Cyrix PCs

	EP5 LP200	Gateway PS-200 FPC	HP Vectra VL 5/200 MT Series 4	Hymco User-200	IBM PC 350	Mega Impact Pentium200+	Micro Express MicroFlex-PC/200
■ YES ■ NO							
Products listed in review order							
Price of tested configuration	\$2,195 (direct)	\$3,437 (direct)	\$2,840 (street)	\$2,500 (direct)	\$3,870 (street)	\$2,950 (street)	\$3,419 (direct)
Processor	Pentium/200	Pentium/200	Pentium/200	Pentium/200	Pentium/200	Pentium/200	Pentium/200
Installed RAM	16MB SDRAM	16MB SDRAM	16MB EDO	16MB EDO	16MB	16MB EDO	16MB EDO
Hard disk	Western Digital Caviar AC32500	Seagate Medalist ST32140A	Western Digital Caviar AC31600	Western Digital Caviar AC31600	IBM Deskstar DA0A-33240	Quantum Atlas XP32150W	Quantum Atlas XP32150W
Capacity and interface	2.5GB EIDE	2GB Fast ATA-2	1.5GB EIDE	1.5GB EIDE	3GB ATA-3	2GB Fast/Wide SCSI-2	2GB Fast/Wide SCSI-2
Graphics adapter	Diamond Stealth3D 2000	STB Lightspeed 128	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Number Nine Imagine 128 Series II	STB Lightspeed 128
Memory	2MB EDO	2MB MDRAM	2MB WRAM	4MB WRAM	4MB WRAM	4MB VRAM	2MB MDRAM
Monitor (and screen diagonal claimed/measured, in inches)	CTX 1585D (15,14)	Sony Vivitron 17 (17,16.3)	HP Ultra VGA 1280 (17,15.8)	Acer 761g (17,15.8)	IBM P50 (15,13.9)	MGC DCM-1588E (15,14)	MAG InnoVision DX1795 (17,16.3)
CD-ROM drive (speed)	Hitachi CDR-7930 (8X)	Toshiba XM-5602B (8X)	Hitachi CDR-7730 (4X)	Toshiba XM-5522B (6X)	Hitachi CDR-7930 (8X)	Toshiba XM-5602B (8X)	Sony CDU311 (8X)
Sound adapter	Ensoniq SoundscapeVIVO	Ensoniq SoundscapeVIVO	Creative Labs Vibra 16	Yamaha OPL3-SA	Creative Labs Sound Blaster AWE32 PnP	Creative Labs Vibra 16	Creative Labs Sound Blaster AWE32
Speakers	Labtec LCS-3210	Altec Lansing ACS40	Labtec LCS-600	JUSTer Active SP-690	Cambridge SoundWorks SWK1	Kingtex EP-120	Sound Land SL-180
Modem speed (data/fax, in Kbps)	28.8/14.4	28.8/14.4	N/A	N/A	N/A	33.6/14.4	N/A
Network adapter	Intel EtherExpress PRO/100	N/A	N/A	N/A	N/A	N/A	N/A
Motherboard Components							
Installed external RAM cache and type	512K pipelined-burst	256K pipelined-burst	256K pipelined-burst	256K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst
Motherboard manufacturer	BCM	Intel	HP	Intel	IBM	BCM	Micro Express
Chip set	Intel 82430VX	Intel 82430VX	Intel 82430FX	Intel 82430HX	Intel 82430HX	Intel 430HX	Intel 82430VX
Expandability							
Maximum RAM	256MB	64MB	128MB	128MB	192MB	256MB	256MB
Expansion-bus slots	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA
Bays: accessible (5.25", 3.5")/internal (5.25", 3.5")	3, 2; 0, 2	4, 1; 0, 7	3, 1; 1, 2	2, 2; 0, 2	2, 1; 0, 2	3, 2; 0, 1	3, 2; 0, 2
Parallel/serial/mouse ports	1, 2, 1	1, 1, 1	1, 2, 1	1, 2, 1	1, 1, 1	1, 3, 1	1, 2, 0
Service and Support							
7-day, 24-hour live technical support	■	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/1 year	3 years/3 years	3 years/3 years	2 years/1 year	3 years/3 years	2 years/2 years	2 years/2 years
On-site service charge	Included (1 year)	Included (1 year)	Included (1 year)	\$100.00 (1 year)	Included (1 year)	N/A	\$50.00 (1 year)
N/A—Not applicable. This product does not have this feature. * This system is equipped with a second processor socket.							

Royal Computer Inc. Power Media-15

If you need good hard disk performance at a reasonable price, consider Royal Computer's Power Media-15 (\$2,345 direct), which is positioned as a value business machine, with lots of speed in processing and storage. The unit hits the company's target squarely, with hot disk test scores and average scores on other tests.

Royal starts with an Ampttron motherboard with Intel's 430VX chip set and 512K of L2 cache. The company adds a high-powered hard disk—a 2GB, 7,200-rpm Seagate Fast/Wide SCSI-2 with an Adaptec 2940UW disk controller—and the result was the number-five Disk WinMark 97 score of this roundup. Using an STB Lightspeed 128 adapter, graphics performance was average, as were all other test scores.

Other system components include a Goldstar 8X CD-ROM drive, a Sound Blaster AWE32 wavetable audio card, and Cam-

bridge SoundWorks speakers with a subwoofer. In addition to Windows 95, Royal bundles Lotus SmartSuite 96, InfoPedia, and Quicken SE for Windows with the Power Media-15.

A bountiful software bundle, excellent speakers, and a powerful hard disk at a low price make this machine well worth a second glance.—BB

Power Media-15. Direct price: \$2,345. Royal Computer Inc., City of Industry, CA; 800-486-0008, 818-855-5077; fax, 818-330-2717; Circle 473 on reader service card.

SAG Electronics STA Pentium 200

SAG Electronics' STA Pentium 200 (\$3,099 direct) is aimed at corporate users who want fast graphics performance. The unit's competitive benchmark test results and full complement of high-end components underscore its value. SAG also sells the STFD2000 line of dual-Pentium/200 PCs and the STFD4000 line

PCs
Pentium and Cyrix PCs

Continues

Micro Express MicroFlex- 606/P200+	Micron Millennia Plus	Micron Millennia	MidWest Micro P5-200 Office PC	MITAC Professional 430H	MITAC Pursuit 430V	Mitsuba Premier System-200	NEC PowerMate P2200	Polywell Poly 5200IP5	Polywell Poly 586-200CX
\$2,899 (direct)	\$3,248 (direct)	\$2,507 (direct)	\$2,662 (direct)	\$3,000 (street)	\$2,000 (street)	\$2,100 (street)	\$2,900 (street)	\$3,238 (direct)	\$2,800 (direct)
Cyrix 6x86-P200+	Pentium/200	Pentium/200	Pentium/200	Pentium/200	Pentium/200	Pentium/200	Pentium/200	Pentium/200*	Cyrix 6x86-P200
16MB EDO	16MB DRAM	16MB EDO	16MB SDRAM	16MB EDO	16MB EDO	16MB SDRAM	16MB EDO	16MB EDO	16MB EDO
Quantum Atlas XP32150W	Conner Cayman CP2107S	Western Digital Caviar AC32100	Quantum Sirocco 2550AT	Seagate Barracuda ST32550W	Seagate Medalist ST32140A	Seagate Medalist ST32140A	IBM Deskstar DAQA-33240	Quantum Atlas XP32150W	Quantum Atlas XP32150W
2GB Fast/Wide SCSI-2	2GB Ultra SCSI	2GB EIDE	2.4GB Fast ATA-2	2GB Fast/Wide SCSI-2	2GB Fast ATA-2	2GB Fast ATA-2	3GB ATA-3	2GB Fast/Wide SCSI-2	2GB Fast/Wide SCSI-2
STB Lightspeed 128	Diamond Stealth3D 2000	Diamond Stealth3D 2000	Number Nine Imagine 128 Series II	Cardexpert Technology Challenger EV	Cardexpert Technology Challenger EV	STB Lightspeed 128	ATI GT Rage	STB Lightspeed 128	STB Lightspeed 128
2MB MDRAM	2MB DRAM	4MB EDO DRAM	4MB VRAM	2MB MDRAM	2MB MDRAM	2MB MDRAM	2MB SGRAM	2MB MDRAM	2MB MDRAM
MAG InnoVision DX1795 (17,16.3)	Micron 17FGX (17,15.8)	Micron 17FGX (17,15.8)	Infotek SRC1502L (15,13.6)	MITAC L1768- FDW (17,15.7)	MITAC 1584FS (15, 14.5)	Hyundai HL- 5864e (15,13.5)	NEC MultiSync XV17+ (17,15.6)	Sampo Alpha- Scan 17mx (17,15.8)	Sampo Alpha- Scan 15mx (15,14.3)
Sony CDU311 (8X)	Plextor PX-83CS (8X)	Hitachi CR-7930 (8X)	Acer 885A (8X)	Matsushita CR-583 (8X)	Matsushita CR-583 (8X)	Sony CDU311 (8X)	NEC MultiSpin 8V (8X)	Toshiba XM-5602B (8X)	Toshiba XM-5602B (8X)
Creative Labs Sound Blaster AWE32 IDE PnP	Creative Labs Vibra16C	Creative Labs Sound Blaster AWE32 Upgrade	Creative Labs Sound Blaster 32 IDE PnP	Creative Labs Sound Blaster 32 IDE PnP	Creative Labs Sound Blaster 16 IDE PnP	Creative Labs Sound Blaster 32 IDE PnP	Creative Labs Vibra 16C	Creative Labs Sound Blaster 16 IDE PnP	Creative Labs Sound Blaster 16 IDE PnP
Sound Land SL-180	Advent AV270	Advent AV270	Altec Lansing ACS-31	Integrated	Integrated	JUSter SP-980	NEC PowerMate	QuickShot SoundForce 600	QuickShot SoundForce 600
N/A	N/A	N/A	28.8/14.4	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	3Com 3C595-TX	3Com 3C595-TX	N/A	Intel Ether- Express PRO/100	N/A	N/A
512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	256K pipelined- burst	512K pipelined- burst	512K pipelined- burst
DFI	Micronics	Micronics	ASUSTek	ASUSTek	MITAC	Mitsuba	Intel	Tyan	DFI
VLSI VL82C54x	Intel 82430HX	Intel 82430HX	Intel 82430VX	Intel 82430HX	Intel 82430VX	Intel 82430VX	Intel 82430HX	Intel 82430HX	VLSI VL82C543
256MB	128MB	128MB	128MB	256MB	128MB	128MB	192MB	512MB	256MB
3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA
3, 2, 0, 2	2, 3, 0, 1	2, 3, 0, 1	3, 2, 0, 2	3, 2, 0, 3	2, 1, 0, 2	4, 1, 0, 2	3, 1, 0, 1	3, 2, 0, 2	3, 2, 0, 2
1, 2, 0	2, 2, 1	2, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1
■	■	■	■	■	■	■	■	■	■
2 years/2 years	3 years/1 year	3 years/1 year	3 years/3 years	2 years/1 year	2 years/1 year	2 years/2 years	3 years/3 years	3 years/5 years	3 years/5 years
\$50.00 (1 year)	Included (1 year)	Included (1 year)	N/A	\$99.00 (1 year)	\$99.00 (1 year)	Included (2 years)	Included (1 year)	\$75.00 (1 year)	\$75.00 (1 year)

of quad-Pentium/200 systems.

The STA Pentium 200 uses an Intel Advanced ML ATX-form-factor motherboard with Intel's 430HX chip set and 256K of pipelined-burst L2 cache. The unit's 2GB Seagate Fast/Wide SCSI-2 hard disk, hooked to an Adaptec 2940UW ultrawide disk controller, helped it to achieve a high-average Disk WinMark 97 score. Its graphics subsystem, based on a Number Nine Imagine 128 Series II card, contributed to an average Graphics WinMark 97 score. The Winstone 97 score was on the high side of average.

One of the few tested systems with a SCSI CD-ROM drive, the SAG came with an 8X NEC unit. It also had a Sound Blaster 16 audio card, Labtec Spatializer speakers, and a 15-inch MAG InnoVision monitor.

SAG's toll-free technical support is available during business hours. Good performance and a liberal warranty make the STA Pentium 200 a good choice.—BB

STA Pentium 200. Direct price: \$3,099. SAG Electronics, North Andover, MA; 800-989-3475, 508-683-0339; fax, 508-689-0180; www.sagelec.com. *Circle 474 on reader service card.*

Seanix Technology Inc. ASI 9000

Seanix Technology's ASI 9000 (\$2,310 street) is targeted at small and medium-size businesses looking for good value and reasonable performance. The ASI 9000 has some attractive components and a great price, but its low test scores may be difficult to overlook.

Seanix is located in British Columbia, Canada, where most of its dealers are found (shipping to the United States costs \$50). It started supplying parts to other manufacturers in 1986; in early 1990, it began to make and sell its own PCs. Now it is the largest Canadian-owned PC manufacturer.

SUMMARY OF FEATURES

Pentium and Cyrix PCs

■ YES ■ NO

Products listed in review order

ProGen
DiscoverMPEG II
P200Quantax QP5/200
SM-2Reason Square 5
HO/HXReason Square 5
HX/MARobotech Cobra
XLT 200Royal Power
Media-15SAG STA
Pentium 200

	ProGen DiscoverMPEG II P200	Quantax QP5/200 SM-2	Reason Square 5 HO/HX	Reason Square 5 HX/MA	Robotech Cobra XLT 200	Royal Power Media-15	SAG STA Pentium 200
Price of tested configuration	\$2,499 (direct)	\$2,999 (direct)	\$2,695 (direct)	\$2,495 (direct)	\$2,699 (direct)	\$2,345 (direct)	\$3,099 (direct)
Processor	Pentium/200	Pentium/200	Pentium/200*	Pentium/200	Pentium/200	Pentium/200	Pentium/200
Installed RAM	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO
Hard disk	Western Digital Caviar AC32100	IBM Deskstar DAQA-33240	Quantum Atlas XP32150W	Quantum Sirocco 2550AT	Western Digital Caviar AC32500	Seagate Barracuda ST32550W	Seagate Barracuda ST32550W
Capacity and interface	2GB EIDE	3GB ATA-3	2GB Fast/Wide SCSI-2	2.4GB Fast ATA-2	2.4GB EIDE	2GB Fast/Wide SCSI-2	2GB Fast/Wide SCSI-2
Graphics adapter	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Number Nine Imagine 128 Series II	STB Lightspeed 128	Number Nine Imagine 128 Series II
Memory	4MB VRAM	4MB VRAM	2MB VRAM	2MB VRAM	4MB VRAM	2.5MB MDRAM	4MB VRAM
Monitor (and screen diagonal claimed/measured, in inches)	Panasonic Pana- sync/Pro P17 (17,16)	MAG InnoVision DX17T (17,16.3)	Samsung 17GLI (17,15.8)	Nokia 447W (17,15.3)	Princeton Ultra 17+ (17,15.8)	MAG InnoVision DX1595 (15,14)	MAG InnoVision DX1595 (15,14)
CD-ROM drive (speed)	Toshiba XM-5602B (8X)	Toshiba XM-5602B (8X)	TEAC CD-58E (8X)	TEAC CD-58E (8X)	Acer 685A (8X)	Goldstar GCD- R580B (8X)	NEC CDR-1410A (8X)
Sound adapter	Creative Labs Sound Blaster 32 IDE PnP	Ensoniq SoundscapeVIVO	Ensoniq SoundscapeVIVO	Ensoniq SoundscapeVIVO	Creative Labs Sound Blaster 16 IDE PnP	Creative Labs Sound Blaster AWE32 PnP	Creative Labs Sound Blaster 16 IDE
Speakers	MIDI Land MLI 02	Altec Lansing ACS-400	Yamaha YST-M5	Integrated	Robotech Cobra	Cambridge SoundWorks	Labtec Spatial- izer LCS-3210
Modem speed (data/fax, in Kbps)	33.6/14.4	33.6/14.4	N/A	N/A	28.8/14.4	N/A	N/A
Network adapter	N/A	N/A	N/A	N/A	NDC OpenEthernet 4100	N/A	N/A

Motherboard Components

Installed external RAM cache and type	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	256K asynchronous	256K pipelined- burst	512K pipelined- burst	256K pipelined- burst
Motherboard manufacturer	ProGen	Nexia	Tyan	Intel	Robotech	Ampteron	Intel
Chip set	Intel 82430HX	Intel 82430HX	Intel 82430HX	Intel 82430HX	Intel 82430HX	Intel 82430VX	Intel 82430HX

Expandability

Maximum RAM	128MB	128MB	512MB	128MB	128MB	128MB	128MB
Expansion-bus slots	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 3 PCI	2 ISA, 3 PCI, 1 PCI/ISA
Bays: accessible (5.25", 3.5")/internal (5.25", 3.5")	3, 2, 0, 2	4, 1, 0, 3	4, 1, 0, 2	3, 1, 0, 1	3, 2, 0, 1	3, 2, 0, 3	3, 2, 0, 2
Parallel/serial/mouse ports	1, 2, 1	1, 1, 1	1, 2, 1	1, 2, 1	1, 3, 0	1, 2, 0	1, 2, 1

Service and Support

7-day, 24-hour live technical support	■	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/1 year	3 years/1 year	3 years/5 years	3 years/5 years	3 years/1 year	1 year/lifetime	2 years/2 years
On-site service charge	Included (1 year)	Included (1 year)	\$49.00 (1 year)	\$49.00 (1 year)	Included (1 year)	\$35.00 (1 year)	\$50.00 (1 year)

N/A—Not applicable: The product does not have this feature.

* This system is equipped with a second processor socket.

The ASI 9000 uses a Seanix Yukon motherboard with a SiS chip set and 512K of L2 cache. A 1.6GB EIDE hard disk earned the system an average score on our Disk WinMark 97 tests. But the Seanix-made graphics board bearing a Cirrus Logic chip set held the unit to a below-average score on the Graphics WinMark 97 test. The machine's Winstone 97 score was one of the lowest in the entire roundup.

The unit's additional components include an integrated 16-bit audio chip set and a set of speakers adequate for applications using sound. The system also has a 28.8/14.4-Kbps data/fax modem with voice mail and Caller ID support, and a 15-inch monitor.

If you're looking for a low-priced PC, this machine offers the basics needed for general-purpose computing.—BB

ASI 9000. Street price: \$2,310. Seanix Technology Inc., Richmond, BC, Canada; 800-867-2649, 604-303-2900; fax, 604-303-2932; www.seanix.com. Circle 475 on reader service card.

Sys Technology Inc. Sys Performance P200T2, Sys Performance C200+

At \$3,799 (direct) for either model, the Cyrix 6x86-P200+-based Sys Performance C200+ and the Pentium/200-based Sys Performance P200T2 may cost a bit more, but as their test scores reveal, you get your money's worth.

Each PC comes with a motherboard tray and card cage that slide out for easy upkeep. For top-level graphics, each has a Matrox MGA Millennium graphics card and a 17-inch monitor. Only core components differ: The C200+ has a VLSI Lynx-based DFI motherboard; the P200T2 has an Intel 430HX-based Gigabyte board. Both have Sound Blaster 32 audio cards, MIDI Land speakers, 28.8/14.4-Kbps data/fax modems, and 3Com Fast Ethernet cards.

On every test, the units scored well. The P200T2 produced the highest CPUmark scores here and had a Winstone 97 score in the top ten; the C200+ earned a top-five Winstone score. Both had

PCs
Pentium and Cyrix PCs

Ends

Seenix ASI 9000	Sys Performance P200T2	Sys Performance C200+	Tagram Thunderbolt FX	Tagram Vitesse Virtual Studio	Tangent TCS200T	Tangent TCS200M	Total Peripherals Thunder	Unisys Aquantia DM	Zenon Presentation P200
\$2,310 (street)	\$3,799 (direct)	\$3,799 (direct)	\$2,295 (direct)	\$2,995 (direct)	\$2,295 (direct)	\$2,095 (direct)	\$2,540 (street)	\$2,640 (street)	\$2,649 (direct)
Pentium/200	Pentium/200	Cyrix 6x86-P200+	Pentium/200	Cyrix 6x86-P200+	Pentium/200*	Pentium/200	Pentium/200	Pentium/200	Pentium/200
16MB EDO	16MB EDO	16MB EDO	16MB SDRAM	16MB EDO	16MB EDO	16MB SDRAM	16MB EDO	16MB EDO	16MB EDO
Western Digital Caviar AC31600	Seagate Barracuda ST32550W	Seagate Barracuda ST32550W	Quantum Fireball TM 3200AT	Quantum Atlas XP34300W	Seagate Medalist ST32140A	Seagate Medalist ST32140A	Seagate FilePro ST32161A	Western Digital Caviar AC31600	IBM Ultrastar DORS-32160
1.6GB EIDE	2GB Fast/Wide SCSI-2	2GB Fast/Wide SCSI-2	3GB Fast ATA-2	4GB Fast/Wide SCSI-2	2GB Fast ATA-2	2GB Fast ATA-2	2GB Fast ATA-2	1.5GB EIDE	2GB Fast/Wide SCSI-2
ATI MPEGVIII- 4M	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	STB Lightspeed 128	STB Lightspeed 128	Matrox MGA Millennium	Number Nine Imagine 128 Series II	STB Lightspeed 128
4MB EDO DRAM	2MB WRAM	2MB WRAM	4MB WRAM	4MB WRAM	2MB MDRAM	2MB MDRAM	2MB WRAM	4MB VRAM	2MB MDRAM
Acer S-15AMD2 (15,13.8)	MAG InnoVision DX1795 (17,16.3)	MAG InnoVision DX1795 (17,16.3)	MAG InnoVision DX1595 (15,14)	MAG InnoVision DX1595 (15,14)	CTX 1585D (15,14)	CTX 1585D (15,14)	Goldstar Studio- works 56M (15,14)	Unisys EVG-174- COL (17,15.5)	Goldstar Studio- works 56i (15,14)
Mitsumi CRMC- FX810T (8X)	TEAC CD-58E (8X)	TEAC CD-58E (8X)	Toshiba XM-5602B (8X)	Toshiba XM-3701B (6.7X)	Toshiba XM-5602B (8X)	Toshiba XM-5602B (8X)	Acer 685A (8X)	Toshiba XM-5602B (8X)	TEAC CD-56S (6X)
Seenix	Creative Labs Sound Blaster 32 IDE PnP	Creative Labs Sound Blaster 32 IDE PnP	Ensoniq SoundscapeVIVO	Ensoniq SoundscapeVIVO	Creative Labs Sound Blaster 32 IDE PnP	Creative Labs Sound Blaster 32 IDE PnP	Creative Labs Sound Blaster 16 IDE PnP	Creative Labs Sound Blaster 16 IDE PnP OEM	Creative Labs Sound Blaster 32 IDE PnP
China Success MCA-1201	MIDI Land MLI-65	MIDI Land MLI-65	QuickShot SoundForce 600	QuickShot SoundForce 600	Altec Lansing ACS51	Integrated	Integrated	Altec Lansing ACS-51	MIDI Land MLI-818
28.8/14.4 N/A	28.8/14.4 3Com 3C595-TX	28.8/14.4 3Com 3C595-TX	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	33.6/14.4 N/A
512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	256K pipelined- burst	512K pipelined- burst	512K pipelined- burst	256K pipelined- burst	512K pipelined- burst	512K pipelined- burst
Seenix	Gigabyte	DFI	BCM	DFI	Tyan	Tyan	ASUSTek	Intel	FIC
SIS 551x	Intel 82430HX	VLSI VL82C54x	Intel 82430VX	VLSI VL82C54x	Intel 82430HX	Intel 82430VX	Intel 82430HX	Intel 82430FX	Intel 82430HX
128MB	512MB	256MB	128MB	128MB	512MB	128MB	256MB	128MB	256MB
3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI	3 ISA, 4 PCI
3, 2, 0, 2	3, 2, 0, 2	3, 2, 0, 2	4, 1, 0, 3	4, 1, 0, 3	3, 1, 0, 2	2, 1, 0, 2	3, 2, 0, 2	3, 1, 0, 3	3, 1, 0, 3
1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	3, 1, 1
■	■	■	■	■	■	■	■	■	■
3 years/3 years N/A	2 years/1 year Included (1 year)	2 years/1 year Included (1 year)	1 year/1 year \$49.99 (1 year)	1 year/1 year \$49.99 (1 year)	3 years/3 years Included (1 year)	3 years/3 years Included (1 year)	3 years/3 years Included (3 years)	3 years/3 years Included (1 year)	1 year/lifetime \$130.00 (1 year)

above-average CD-ROM WinMark 97 scores; the P200T2 also had an above-average Disk WinMark 97 score.

High-end graphics will be a snap with these top-performing Sys machines.—BB

Sys Performance C200+. Direct price: \$3,799. **Sys Performance P200T2.** Direct price: \$3,799. Sys Technology Inc., Cypress, CA; 800-613-9963, 714-821-3900; fax, 714-821-9592; www.systech.com. Circle 476 on reader service card.

Tagram System Corp. Thunderbolt FX, Vitesse Virtual Studio

The two Tagram machines in this review are aimed at slightly different markets: The Thunderbolt FX (\$2,295 direct) is an Intel-based midrange business PC, while the Vitesse Virtual Studio (\$2,995 direct) is a well-priced Cyrix 6x86-P200+ multimedia PC catering to the high-end corporate market.

The Thunderbolt uses a BCM motherboard with synchronous DRAM. It delivered above-average scores on the Graphics and CD-ROM WinMark 97 tests, aided by a Matrox MGA Millennium graphics card and an 8X Toshiba CD-ROM drive, respectively. All its other results were average.

The Vitesse Virtual Studio mid-tower turned in above-average scores on our Winstone 97 and Disk WinMark 97 tests, thanks to a 4GB Fast/Wide SCSI-2 hard disk and a Matrox MGA Millennium graphics card. Other test results were average. The Cyrix unit is anchored by a VLSI Lynx-based DFI motherboard and EDO memory, and has a 6.7X SCSI CD-ROM drive.

Both Energy Star-compliant PCs have tool-free chassis, Ensoniq wavetable sound cards, and Quickshot speakers. Both Tagram PCs are good values that should satisfy their target audiences.—CM

Thunderbolt FX. Direct price: \$2,295. **Vitesse Virtual Studio.** Direct price: \$2,995. Tagram System Corp., Costa Mesa, CA; 800-824-

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To



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graphics memory that bring true 3D arcade-quality images home for the first time ever. Translation: frightening realism and incredibly smooth animation.

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7267, 714-979-8900; fax, 714-979-8970; www.tagram.com. Circle 477 on reader service card.

Tangent Computer Inc. **TC5200T, TC5200M**

Aimed at the business market, Tangent Computer's offerings are well thought out and priced to move. The \$2,295 TC5200T is a mini-tower unit for power users, and the \$2,095 TC5200M is a desktop unit with speakers integrated into the case for those who want a good multimedia value. Both were good performers.

The TC5200T's case houses a Tyan motherboard with EDO DRAM; this board can support two processors. The TC5200M uses a different Tyan motherboard and synchronous DRAM.

The two PCs have some parts in common, including 512K of L2 cache; a 2GB, 5,400-rpm Fast ATA-2 hard disk; an 8X CD-ROM drive; and an STB Lightspeed 128 graphics card. Both were mostly average performers, except for both units' above-average CD-ROM WinMark 97 scores.

Each unit also comes with a Creative Labs wavetable sound card. The TC5200M also features built-in volume control, a microphone, I/O multimedia jacks, a stereo earphone jack, a line-in jack, a video-in/out jack, a game port, and a MIDI port.

These Tangent PCs are an excellent value, in all respects. Their prices are extremely competitive, performance was impressive, and their features sets are well rounded.—*MEB*

TC5200T. Direct price: \$2,295. **TC5200M.** Direct price: \$2,095. Tangent Computer Inc., Burlingame, CA; 888-826-4368, 415-342-

9388; fax, 415-342-9380; www.tangent.com. Circle 478 on reader service card.

Total Peripherals Inc. **Thunder**

For an appealing \$2,540 street price, Total Peripherals' Thunder provides all of the basics you'd want in a corporate or all-purpose system, plus competitive performance and a good warranty to boot. Total Peripherals also sells the Lightning line for engineers and Workhorse units for corporations and schools.

The Thunder's mini-tower case is home to an ASUStek motherboard with Intel's 430HX chip set, a Pentium/200 CPU, EDO DRAM, and 256K of pipelined-burst L2 cache. Sound is handled by the popular Creative Labs 16 IDE PnP card with FM synthesis, while graphics are covered by a Matrox MGA Millennium adapter with 2MB of WRAM. Other hardware includes a Seagate 2GB 5,400-rpm hard disk, an Acer 8X CD-ROM drive, and a Goldstar Studioworks 56M 15-inch monitor with built-in speakers.

These components contributed to an average score for the Thunder on our Business Winstone 97 tests. Most of the unit's other scores were also average.

The Thunder's generous three-year warranty, solid parts, and average performance will get the job done.—*MEB*

Thunder. Street price: \$2,540. Total Peripherals Inc., Northborough, MA; 800-422-1139, 508-393-1777; fax, 508-393-5794; www.totalpc.com. Circle 479 on reader service card.

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Unisys PC Division **Aquanta DM**

Unisys aims its high-end, multimedia Aquanta DM at power users. On our benchmark tests, the Aquanta DM (\$2,640 street) was an average performer; it includes good components, such as an 8X Toshiba CD-ROM drive and a Number Nine Imagine 128 Series II graphics card with 4MB of VRAM. Unisys also markets the midrange Aquanta DX line and the low-end Aquanta DL series.

The unit's Pentium/200 chip sits on an Intel motherboard with 512K of pipelined-burst L2 cache. These elements led to average CPUmark scores. A Western Digital Caviar AC31600 hard disk held the unit to a slightly below-average Disk WinMark 97 score; its Winstone 97 results were average, however. The Number Nine graphics card held its own against the field, helping to produce an average score on our Graphics WinMark 97 test. The Toshiba XM-5602B ATAPI CD-ROM drive was responsible for an above-average CD-ROM WinMark 97 score.

Also included was a Creative Labs Sound Blaster 16 IDE PnP OEM card, which supports FM synthesis. A Unisys-labeled 17-inch monitor, headphones, and a pair of Altec Lansing AC551 speakers rounded out the hardware.

The Aquanta DM offers good components that yield mostly average performance, all at a fair price.—MEB

Aquanta DM. Street price: \$2,640. Unisys PC Division, San Jose, CA; 888-278-2682, 408-434-2848; fax 408-434-4844; www.pc.unisys.com. Circle 480 on reader service card.

Zenon Computer Inc. **Presentation P200**

The \$2,649 (direct) Presentation P200 is one of three PCs here to include a 16MB caching disk controller. As a result, its Disk WinMark 97 score was astronomical. Aimed at CAD and Photoshop users, the unit was an average to above-average performer on most other tests. Zenon also offers the Dream Media Plus line of multimedia workstations, the low-cost Win Station line, and the Optima Pro workstation line for Windows NT.

The unit is centered around an FIC motherboard with 512K of pipelined-burst L2 cache. An impressive hardware set features a 2GB IBM Fast/Wide SCSI-2 hard disk hooked to a CMD 16MB caching disk controller, and an STB Lightspeed 128 graphics card based on the Tseng ET6000 chip set. The unit posted one of the top Disk WinMark 97 scores, an above-average Winstone 97 score, and an average Graphics WinMark 97 result. A 6X TEAC CD-565 CD-ROM drive led to a subpar CD-ROM WinMark 97 score.

Other components included an Apache 33.6/14.4-Kbps fax modem with voice mail capabilities, a 15-inch GoldStar Studioworks 56i monitor (a 15-inch monitor will be standard by the time you read this), and MIDI Land MLI 818 speakers.

Zenon's Presentation P200 is a top performer at a competitive price.—MEB □

Presentation P200. Direct price: \$2,649. Zenon Computer Inc., City of Industry, CA; 800-899-6119, 818-935-1828; fax, 818-935-1826; www.primenet.com/~zenon. Circle 481 on reader service card.

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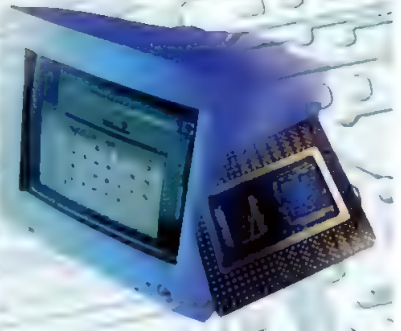
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CORPORATE VOICES

PC Labs examines 40 200-MHz Pentium Pro systems running Windows NT 4.0 with our new 32-bit benchmark tests.

BY CADE METZ



Success is often symbiotic. Such is the case not only with composers and lyricists or pitchers and catchers, but with hardware and software manufacturers as well. The inaugural IBM PC needed Microsoft's disk operating system; DOS needed a disk on which to operate. Windows 3.1 and the 386 later showed a similar synergy, before Windows 95 and the Pentium became pop icons in tandem. Today, no two products are as interdependent as the Pentium Pro and Windows NT. Although each can operate with other partners, neither could hope for mainstream success without the other.

After a lengthy stay on the outskirts of the mainstream, this pair has finally arrived. In these pages, *PC Magazine* reviews 40 Pentium Pro PCs and tests them with Windows NT, Version 4.0.

LONG AND WINDING ROAD

When Windows NT debuted in 1993, its strengths were abundant: preemptive multitasking, independence from DOS, security, stability, full 32-bit performance. Yet it was rare for anyone but seasoned programmers and graphic artists to use this new OS. It required an expensive, top-of-the-line 486, lacked support from mainstream applications, and had to compete with OS/2 2.1—then a serious rival. Two years later, system requirements had become affordable and Windows NT had gone through several updates, but the OS was still as inconspicuous as ever.

In the fall of 1995, Windows NT stood to receive a shot in the arm with the introduction of the Pentium Pro, a chip optimized for 32-bit code. Sales of Windows NT certainly increased, but the full 32-bit platform was far from a mainstream option: The first Pentium Pro was exceedingly expensive, while Windows 95 had rendered the Windows NT interface archaic. Of course, Windows 95 was performing a very necessary function: It was bridging the gap between 16- and 32-bit computing, providing compatibility with existing applications while spawning a generation of mainstream 32-bit software.

Because of its dual personality, many corporations saw Windows 95 as a transitional OS and decided to stay with Windows 3.1. According to Giga Information Group, Windows 3.1 will still command 43 percent of all desktops by the end of 1996, while Windows 95 will have usurped only a quarter of the market. A prominent portion of

the corporate world has been patiently awaiting an updated Windows NT and an affordable Pentium Pro on which to run it. Both arrived this fall.

GETTING BETTER TOGETHER

On November 1, Intel announced new pricing for its chips, as it does every quarter. The price of the 200-MHz Pentium Pro decreased again, but the 200-MHz Pentium's remained the same, so that the two are closer in price than ever before.

Choosing the Pentium Pro can also significantly reduce the cost of PC ownership. Not only will it have a longer life than the Pentium, but Pentium Pro desktops offer an easier upgrade to a second processor: Of the 40 units in this roundup, 13 provided support for two CPUs.

Pentium Pro systems reduce costs even further through the manageability that they yield. Twelve of the machines reviewed here support DMI (Desktop Management Interface), and six of those have MIF (management information file) browsers. DMI allows you to monitor systems on a network easily from a central console, via a software package in the vein of Intel's LANdesk. Only machines equipped with MIF browsers can take full advantage of DMI, but these systems should soon be more prevalent.

The Pentium Pro, however, cannot obtain mainstream success in the near future with mere affordability. Because it is not optimized for 16-bit code and may not perform as well as the Pentium under Windows 95, it needs the help of a mainstream 32-bit operating system. It needs Windows NT 4.0. The new version of the

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Editors' Choice

- Personal workstation: Dell Dimension XPS Pro200n
- Corporate workstation: Dell OptiPlex GXpro 200



To receive an Editors' Choice award, a PC must get it right on all counts, from features and performance to serviceability and support. Our two Editors' Choices in this Pentium Pro roundup testify to Dell's ability to build not only a machine perfect for mainstream

users but one for the corporate set running Windows NT as well.

Our first Editors' Choice in this Pentium Pro roundup is the \$3,349 (direct) Dell Dimension XPS Pro200n. Everything about the Pro200n is big and fast, from its capacious 3GB hard disk to its 8X CD-ROM drive (which will be upgraded to a 12X model for the same price by the time you read this), its 28.8/14.4-Kbps fax modem (33.6/14.4-Kbps by the time you read this), and its 17-inch Dell UltraScan monitor. The Pro200n was also a highly competitive performer on our benchmark tests, logging scores that met the competition on every count. Dell rounds out the Pro200n's package with a 16-bit sound card, a set of Altec Lansing speakers, and a copy of Microsoft Office Professional.



Our second Editors' Choice is a perfect pick if you want a network-ready, corporate-oriented PC: the \$3,802 (direct) Dell OptiPlex GXpro 200. It's one of only a handful of PCs here that not only are DMI-compliant but also provide an all-important MIF browser, so you can easily monitor and update their assets. Servicing the unit's OptiFrame chassis is very easy: Accessing the innards requires no tools, and the power supply swings out of the way for service. All expansion cards are on a riser board for easy maintenance. The chassis is fully biodegradable, and you can even have Dell dispose of the system for you once it reaches the end of its life cycle. To this base Dell adds on-board 10-Mbps Ethernet and 16-bit audio, a 2GB Seagate hard disk, an 8X CD-ROM drive, speakers, and a 17-inch monitor.

32-bit OS still affords excellent security and stability and has added the user-friendly interface of Windows 95. This feature alone will motivate widespread graduation to the Pentium Pro.

In addition, Version 4.0 is optimized for use with the Pentium Pro and taps into several of its system manageability features. Although recent PC Labs tests showed no significant difference in the performance of Versions 4.0 and 3.51, a disparity should be evident once graphics card and hard disk vendors release drivers optimized for 4.0. And unlike Windows 95, the new Windows NT supports multiple processors, a feature that dovetails with many Pentium Pro desktops and contributes to a lower cost of ownership.

IN THIS REVIEW

In this roundup of Pentium Pro machines running Windows NT 4.0, we review PCs with 200-MHz clock speeds and 256K on-board caches. These 40 PCs have an average price of only \$3,745 and go as low as \$2,699, yet they meet fairly impressive requirements: a 1.6GB hard disk (minimum), a quad-speed CD-ROM drive (minimum), 16-bit sound card (or integrated sound subsystems) and speakers, Super VGA graphics with 4MB of memory, and a 17-inch monitor. Seven also ship with their own Fast Ethernet cards to allow integration into a corporate LAN. Each test unit had 32MB of memory.

Because our testing directly followed the release of Windows NT 4.0, the experience was somewhat harrowing. IRQ

and address conflicts abounded. Certain drivers worked only when we loaded them on top of certain other drivers. Certain peripherals worked only in the absence of certain other peripherals. Some of these problems are attributable to the fact that Windows NT still lacks Plug and Play support, but manufacturers should be correcting many of them in the coming weeks.

As manufacturers update their drivers and optimize them for Windows NT 4.0, the performance of these machines should improve. As a result, you should take this roundup's performance results lightly.

NOW AND THEN

The quality of 32-bit computing will soon improve via Intel and Microsoft enhancements and third-party competition, though many PC buyers will be content to have inexpensive Pentium Pro systems together with Windows NT 4.0 and its mod interface. Even now, the Pentium Pro and Windows NT 4.0 combination can compete for many of the same users as the Pentium Classic with Windows 95. Both tomorrow and yesterday are here today.

Our Contributors: ROBERT S. ANTHONY is a senior writer, CADE METZ is a staff writer, BRUCE BROWN and WINN L. ROSCH are contributing editors, MARY E. BEHR and ANUSH YEGYAZARIAN are staff editors, and RICHARD S. SHIM is an editorial researcher at *PC Magazine*. FRANK J. EVANS is a freelance writer and frequent contributor to *PC Magazine*. CAROL VENEZIA was the associate editor in charge of this story, and RICHARD FISCO was the project leader.

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Price/Performance Index: Pentium Pro PCs

The \$3,662 Gateway G 6-200 FPC is the price/performance leader in this roundup. It offers top hardware, such as a 2GB Ultra SCSI hard disk, a Toshiba 8X CD-ROM drive, and a Matrox MGA Millennium graphics board. The unit posted above-average scores on our ZD High-End Graphics WinMark 97 and ZD CD-ROM WinMark 97 tests.

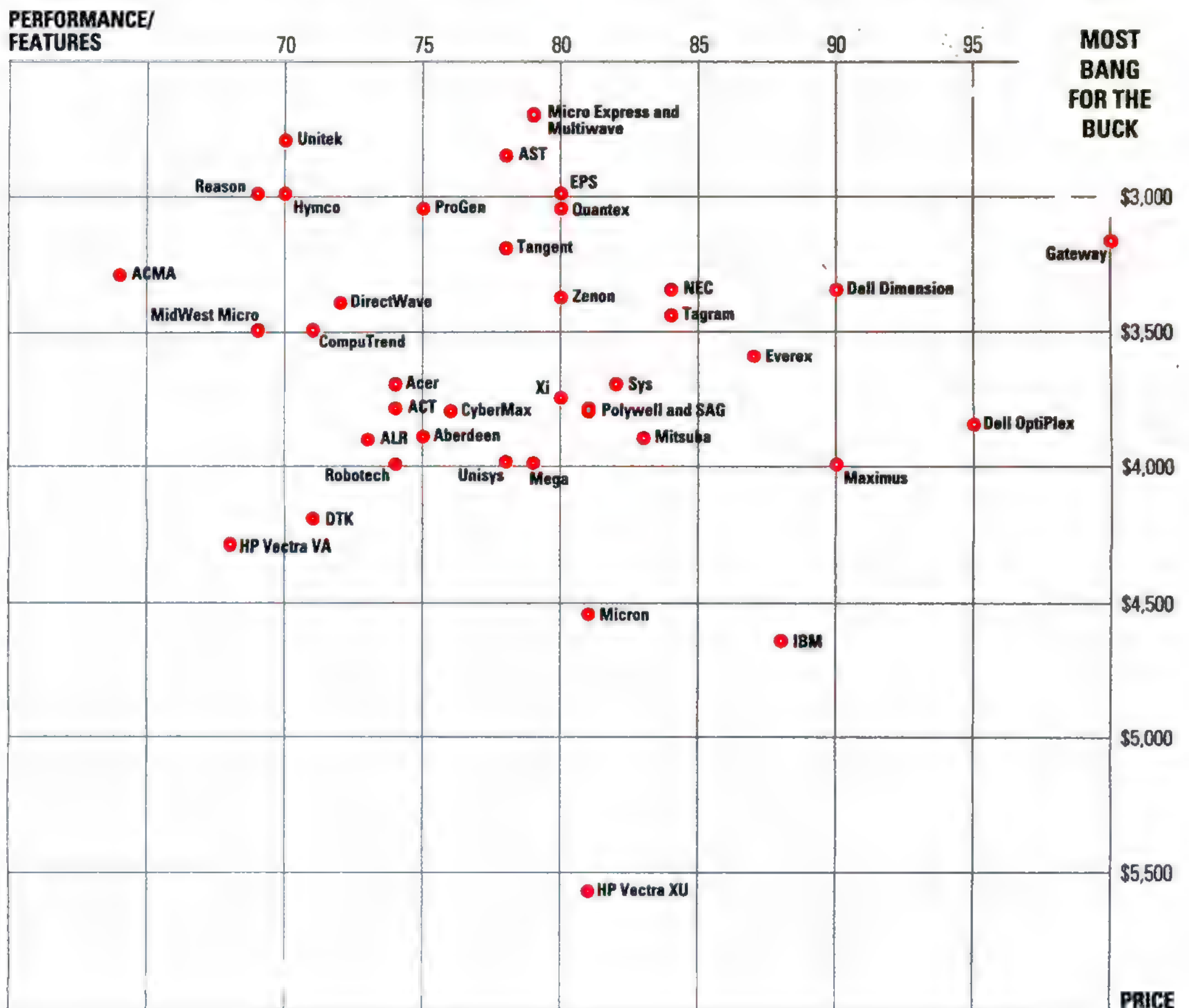
The \$3,802 Dell OptiPlex GXpro 200, one of our Editors' Choices, is another front-runner in this section. Integration is among the system's specialties: The motherboard has an on-

board, 16-bit Creative Labs Vibra 16 audio subsystem as well as a 10-Mbps Ethernet adapter. This PC garnered the highest score of the roundup on our ZD High-End Graphics WinMark 97 tests. Dell Computer Corp. earned an A in our 1996 Service and Reliability survey.

THE DATA POINTS

Test scores on the ZD Business Winstone 97, ZD High-End Winstone 97, and ZD CD-ROM WinMark 97 account for 27 percent of the price/performance score. DMI compliance and

the inclusion of a network card count for 10 percent. Hard disk size, the monitor's diagonal screen measurement, and the amount of graphics memory count for another 16 percent. Various warranty and service measures count for 15 percent. The remaining points depend on certain hardware features, such as the number of free drive bays. You can find price/performance data online either in the Hardware Library of the Editorial Forum on PC MagNet under 21bang1.txt or on the Web at www.pcmag.com.



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Aberdeen Inc. **Aberdeen Dual Pro 200**

Aberdeen offers a dual-socket system for \$3,895 (street) with its Aberdeen Dual Pro 200. A good fit for high-end corporate users and home power users, this PC boasts an external Fast/Wide SCSI port and a DSP modem with telephony features.

The Dual Pro 200's tower chassis has adjustable feet; doors swing open for easy access; rear ports are labeled. The unit has a U.S. Robotics Sportster 33.6/14.4-Kbps fax modem, with both voice mail and full-duplex speakerphone functions. A unique component that houses two speakers as a single unit fits underneath the system's KDS monitor and plugs into a Creative Labs AWE32 wavetable sound card.

The Dual Pro 200 supports a second CPU via a Natoma chip set and a SuperMicro motherboard. Aberdeen also makes use of a Matrox MGA Millennium graphics board, a Fast/Wide SCSI-2 hard disk, and an 8X CD-ROM drive. The last of these delivered an above-average CD-ROM WinMark 97 score; the unit's hard disk test score was also above average. All other benchmark test scores were average.

If good modem and dual-CPU capabilities are on your wish list, the Aberdeen Dual Pro 200 should prove satisfactory. Its price, however, does not include on-site service, which is \$229.95 extra for four years.—*Cade Metz*

Aberdeen Dual Pro 200. Street price: \$3,895. Aberdeen Inc., Santa Fe Springs, CA; 800-552-6868, 310-801-5626; fax, 310-801-5629; www.aberdeeninc.com. *Circle 441 on reader service card.*

Acer America Corp. **AcerPower Pentium Pro**

The \$3,699 AcerPower Pentium Pro ensures satisfaction with a state-of-the-art hard disk, a hearty host of Acer components, and a generous three-year on-site warranty. Besides this performance-oriented corporate PC, Acer offers an AcerPower Business Multimedia PC, a value-based AcerEntra system, and its Acer Aspire home line.

The AcerPower's tool-free mini-tower chassis opens easily to reveal an Acer motherboard with Intel's Natoma chip set and a 7,200-rpm 2.1GB Seagate Fast/Wide SCSI-2 hard disk. Graphics are handled by a Diamond Stealth card, sound by a 16-bit Cre-

ative Labs board that supports FM synthesis. On our benchmark tests, the graphics score was below average and the hard disk above average; the rest were average.

An Acer 4X ATAPI CD-ROM drive—which was a below-average performer on our CD-ROM WinMark 97 test—is supported by two modest QuickShot Sound Force 550 speakers. An AcerView 76ie monitor (with a 15.8-inch viewing area) supports DDC1 and DDC2 and is Energy Star-compliant. The system itself is Energy Star- and DMI-compliant—with a MIF browser preloaded—and it boasts a SCSI port and a USB port as well.

The AcerPower Pentium Pro can ably serve your company today and in the future.—*CM*

ACMA Computer Inc. **Acma zPower Pro 200**

The Acma zPower Pro 200 (\$3,295 direct) scores points for ease of use, offering features such as a tool-free case and a setup guide. The machine's target audience—demanding corporate users who require multimedia—is well provided for with a collection of capable hardware.

The zPower Pro's tool-free mid-tower chassis opens easily to expose an organized arrangement of internal hardware. An Intel Performance/VS motherboard supports the Natoma chip set, a Matrox MGA Millennium graphics card, and a 16-bit Creative Labs FM-only sound card. The system's CD-ROM controller is integrated on the motherboard and connects to a Toshiba 8X CD-ROM drive, which delivered an above-average CD-ROM WinMark 97 score. The Disk WinMark, Business Winstone, and High-End Winstone scores were below average; all other scores were average, however.

The interior is well designed, though it offers little room for additional drives; however, several bus slots are available for expansion. To aid first-time users, ACMA labels some of the ports on the rear of the system and provides a setup poster. ACMA ships this machine with an Impression Vienna monitor (DDC1- and DDC2-compliant), Altec Lansing speakers, and an ergonomic Microsoft keyboard.

The zPower Pro covers most bases. But if you need good sound, consider an upgrade to a wavetable sound board.—*CM*



AcerPower Pentium Pro. List price: \$3,699. Acer America Corp., San Jose, CA; 800-558-2237; fax, 408-922-2933; www.acer.com/aac. *Circle 442 on reader service card.*

ACMA zPower Pro 200. Direct price: \$3,295. ACMA Computer Inc., Fremont, CA; 800-786-6888, 510-623-1212; fax, 510-623-0818; www.acma.com. *Circle 443 on reader service card.*

ACT P6-200BA. Direct price: \$3,788. All Computer Technology, City of Industry, CA; 800-775-1953, 818-369-4181; fax, 818-961-7462; www.allcomp.com/acw. *Circle 444 on reader service card.*



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Advanced Logic Research Inc. **ALR Evolution Dual 6/200**

For \$3,910 (street), the ALR Evolution Dual 6/200 provides an easy upgrade to a second CPU and system management software—features designed to appeal to a target audience of high-end corporate users and graphics professionals.

ALR's SMP motherboard has two processor sockets; it also carries Intel's 450KX chip set and ECC DRAM. The mini-tower case houses a 1.5GB EIDE hard disk and a Diamond Stealth 64 graphics card. A translucent locking door protects the floppy disk drive and the 4X CD-ROM drive (8X will be standard by the time you read this). All benchmark test scores were below average except for an average CPUmark₃₂ score.

The Evolution Dual 6's Labtec C5-600 speakers plug into a Creative Labs Sound Blaster card to provide good stereo sound. The MAG InnoVision monitor offers a 15.9-inch viewing area as well as DDC1 and DDC2 compliance. ALR also provides a soft power-down feature, a Cogent Fast Ethernet card, and its Infor-Manager software for monitoring system vital signs.

The bundled network card and management software make the Evolution Dual 6 a worthy corporate purchase; the imminent inclusion of an 8X CD-ROM drive will bring the standard components up to date.—CM

ALR Evolution Dual 6/200. Street price: \$3,910. Advanced Logic Research Inc., Irvine, CA; 800-444-4257, 714-581-6770; fax, 714-581-9240; www.alr.com. Circle 482 on reader service card.

All Computer Technology **ACT P6-200BA**

Priced at \$3,788, the ACT P6-200BA is a relative bargain with its four-CD-ROM changer, 33.6-Kbps modem, bundled Lotus SmartSuite, and convenient serviceability. High-end corporate users, the machine's target audience, will find the P6-200BA well worth the cost but can also choose from ACT's full line of Pentium PCs or dual-processor Pentium Pros.

The ACT P6-200BA's most distinguishing feature is its Nakamichi four-disk CD-ROM changer, an 8X drive; however, the system delivered a below-average score on our CD-ROM WinMark 97 tests.

The mini-tower chassis is quite full: The expansion slots on its Super Micro motherboard are occupied by a Creative Labs 32-bit wavetable sound card, a Supra 33.6/14.4-Kbps voice mail modem, and a Number Nine Imagine 128 Series 2 graphics card. With the removal of four screws, the motherboard—cards and all—can be taken out with little exertion. Storage is handled by a Seagate 2GB 5,400-rpm Ultra SCSI hard disk; the unit's Disk WinMark scores were below average, however. All other benchmark test scores were average.

The ACT P6-200BA comes with a MAG InnoVision monitor (15.9-inch viewing area) and two MLI-95 speakers. A removable

motherboard and four-disk changer, in particular, make it a worthy purchase.—CM

AST Computer **AST Bravo MS-T 6200**

The \$2,860 AST Bravo MS-T 6200 mini-tower offers a software security program, ample expansion room, and competitive benchmark test performance—all at a very attractive price. The Bravo MS-T 6200 leads AST's Bravo MS-T Pro line of commercial desktops, which ranges from the value Pentium-based Bravo LC to the high-end Pentium-based Bravo MS/MS-T.

The DMI-compliant Bravo MS-T 6200 comes with AST

Command Center software, which includes an antivirus utility, a hardware inventory application (akin to a MIF browser), and a system security application. The mini-tower case has a metal padlock loop for greater security.

The unit is configured with a 2.1GB hard disk, a 6X CD-ROM drive, a Matrox MGA Millennium graphics board, and a 17-inch ASTVision monitor. The unit's single-CPU, ATX-style motherboard offers an integrated 16-bit FM synthesis audio subsystem. The Bravo's High-End Graphics WinMark 97 score was above average, but its High-End Disk WinMark 97 score was below average. All other test scores were average.

The Bravo MS-T 6200 represents a good value in all respects, from performance and features to software and support.—Robert S. Anthony

AST Bravo MS-T 6200. Street price: \$2,860. AST Computer, Irvine, CA; 800-876-4278, 714-727-4141; fax, 714-727-9355; www.ast.com. Circle 446 on reader service card.

CompuTrend Systems Inc. **Premio FX Pro200**

While the Premio FX Pro200 mid-tower (\$3,499 street) offers some high-end components, its performance lagged behind that of many other units reviewed here. CompuTrend markets motherboards, monitors, and PCs under the Premio brand name, selling direct and through authorized resellers. The company offers standard Pentium Pro workstation configurations but also builds PCs to order.

Our test unit's Premio motherboard had 512MB RAM but can support 1GB with 256MB memory modules. It comes with a Quantum 2.1GB Fast/Wide SCSI-2 hard disk, a Mitsumi 8X ATAPI CD-ROM drive, a 17-inch Premio monitor, a Number Nine Imagine 128 graphics card, a Creative Labs Sound Blaster 16 FM synthesis sound card, and a pair of MLI speakers.

The system fell below the average on our High-End Winstone 97 test but was average on the High-End Disk WinMark 97 test. Its High-End Graphics WinMark 97 score was one of the lowest in this roundup.

Packed with good components, the Premio FX is an adequate purchase.—RSA

RECENT REVIEWS

The Power of Four

October 22, 1996Page 197

We review eight quad-processor, Pentium Pro-based application servers.

Pentium Pro PCs: Power to the People

September 24, 1996Page 146

We look at 45 200-MHz Pentium Pro PCs.

Portable Property

August 1996Page 100

We examine 58 Pentium-class color notebooks.

CyberMax Computer Inc. **ProMax 3-P200**

The ProMax 3-P200 (\$3,799 direct) should fill the bill for even the most demanding workstation users with its capacious 4.3GB hard disk, competitive performance, and in-depth documentation. The ProMax 3-P200 is one of four ProMax PCs from CyberMax, all of which use the 200-MHz Pentium Pro CPU but which vary in peripherals and software. The company also sells Cyrix- and AMD-based PCs.

The ProMax 3-P200 boasts the largest hard disk in this roundup—a 4.3GB Seagate Hawk Fast/Wide SCSI-2 unit. The machine is also configured with a Matrox MGA Millennium graphics card, a Toshiba 6.7X CD-ROM drive, and a Garnet Systems 28.8/14.4-Kbps fax modem. The system's multimedia components are respectable: an Ensoniq Soundscape 16-bit wavetable sound card, Altec Lansing ACS31 speakers, and a 17-inch Princeton monitor. Software includes Compton's Reference Collection CD.

The ProMax 3-P200 was a strong performer: Its High-End Winstone 97 score was above average, and its High-End Graphics WinMark 97 test score was one of the top five in this roundup. On our High-End Disk WinMark 97 test, the system posted an average score.

The huge hard disk, great performance, and excellent documentation add up to a bargain.—RSA

Dell Computer Corp. **Dimension XPS Pro200n, OptiPlex GXpro 200**



It's not often that we see two PCs from one vendor that, even though they represent two distinct product lines, manage to get it right on all counts. This roundup, however, includes two such systems: the \$3,349 Dimension XPS Pro200n value PC and the \$3,802 OptiPlex GXpro 200 corporate PC, both from Dell Computer. Both earn well-deserved Editors' Choices in this roundup.

The OptiPlex GXpro 200 mini-tower is easy to handle by both network administrators and servicepeople. It is not only DMI-compliant but also has a MIF browser. Inside the tool-free OptiFrame chassis, the power supply swings away for clear access to the motherboard, which has an integrated 3Com 10-Mbps Ether-

net adapter. Expansion slots are on a riser that slides out easily.

The Dimension XPS Pro200n mini-tower has a 3GB hard disk, a 8X CD-ROM drive (12X should be standard by the time you read this), a Number Nine Imagine 128 Series 2 graphics board, a 28.8/14.4-Kbps fax modem (upgraded to 33.6/14.4 Kbps by press time), and a 17-inch monitor.

The Dimension logged average scores on all our benchmark tests. The OptiPlex garnered an above-average High-End Graphics WinMark 97 score. Its High-End Winstone 97 score was average, but the High-End Disk WinMark 97 and CD-ROM WinMark 97 scores fell below.

Both Dell PCs serve well: the Dimension, with lots of bang for the buck, and the OptiPlex, with its ease of use, and serviceability.—RSA

DirectWave Inc. **Blue Thunder PN200 MVP6 ProS**

The Blue Thunder PN200 MVP6 ProS mini-tower (\$3,399 direct) is a reasonable choice, with average performance, a competitive price, and an easy-to-service design.

This unit has a single-socket ASUSTek motherboard with four PCI slots, two ISA slots, and a combination PCI/ISA/MediaBus slot that can be used with special graphics/audio cards. The motherboard slides out, with all expansion boards in place, after you remove a few screws.

The system includes a Creative Labs Sound Blaster 32 wavetable sound card and a GVC Mactech 33.6-Kbps fax modem. It also features a 17-inch MAG monitor, two Macase speakers, and a set of Spaceteck headphones. A DirectWave Easy Startup videotape helps novices.

The Blue Thunder was a consistent performer on our tests, posting mostly average scores. It had two high points: above-average scores on both the Disk WinMark and CD-ROM WinMark 97 tests, thanks to its Quantum 2.1GB Fast/Wide SCSI-2 hard disk and Toshiba 8X CD-ROM drive.

The Blue Thunder has all the components you need to get up and running, topped off by good performance.—RSA

Blue Thunder PN200 MVP6 ProS. Direct price: \$3,399. DirectWave Inc., Ontario, CA; 800-882-8108, 909-390-8098; fax, 909-390-8060. *Circle 454 on reader service card.*



Premio FX Pro200. Street price: \$3,499. Computrend Systems Inc., City of Industry, CA; 800-677-6477, 818-333-5121; fax, 818-369-6803; www.premiopc.com. *Circle 448 on reader service card.*

ProMax 3-P200. Direct price: \$3,799. CyberMax Computer Inc., Allentown, PA; 800-443-9868, 610-770-1808; fax, 800-599-7576; www.cybmax.com. *Circle 450 on reader service card.*

Dimension XPS Pro200n. Direct price: \$3,349. **OptiPlex GXpro 200.** Direct price: \$3,802. Dell Computer Inc., Austin, TX; 800-388-8542, 512-338-4400; www.dell.com. *Circle 452 on reader service card.*

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BENCHMARK TESTS

Pentiums Pro PCs



These 40 Pentium Pro PCs pack all of the high-powered components that you'd expect in systems of this class.

And while performance was definitely impressive, it should get even better when drivers tuned to Windows NT 4.0 are available.

What the Numbers Mean

ZD Business Winstone 97 and ZD High-End Winstone 97

Our new ZD High-End Winstone 97 tests consist of applications that stress the CPU and graphics subsystems. In most cases, PCs that perform well on one set of Winstone tests perform well on the other, particularly PCs with Fast/Wide SCSI-2 or Ultra Wide hard disks, 16MB caching disk controllers, and fast graphics cards.

The 16MB caching disk controllers we saw in this roundup led to interesting results. We found that the caching controller can improve disk performance by as much as 50 percent on the ZD Business Disk WinMark 97 tests. This translates, however, to only about a 4 percent increase in the Business Winstone score. The impact on High-End Winstone scores is even less dramatic, perhaps because the application files are too large for even a 16MB cache, or because they are not easily cached, which would negate the benefit of extra cache.

ZD Business Graphics WinMark 97 and ZD High-End Graphics WinMark 97

Optimized, accelerated graphics drivers were not available in time for us to test them, so we tested all systems with the Microsoft-supplied Windows NT 4.0 drivers. Thus, the scores reported here should only go up when vendors introduce graphics drivers optimized for Windows NT 4.0.

Systems with Matrox MGA Millennium cards produced the top Business Graphics WinMark scores. PCs with Number Nine's Imagine 128 Series 2 cards were a close second overall. On the High-End Graphics WinMark tests, the Dell OptiPlex GXpro 200, with its Number Nine Imagine 128 Series 2 card, bested all of the PCs with Matrox boards.

ZD Business Disk WinMark 97 and ZD High-End Disk WinMark 97

The use of a 16MB CMD caching disk controller helped the Zenon Optima Pro Server post a Business Disk WinMark score nearly 50 percent higher than that of the top-scoring machine without a caching controller. The Tagram Thunderbolt Pro Media used the same CMD caching controller, but it had only 4MB of cache. This gave it only a slight performance boost: On the Business Disk WinMark tests, it posted a score less than 4 percent higher than that of the top-scoring system with no cache.

Caching controllers offered no assistance on the High-End Disk WinMark tests. These tests, modeled after real-world applications, represent the caching abilities of the applications themselves. The additional cache on the controller has little chance to cache disk data and thus offers little or no performance benefit. By contrast, the Business Disk WinMark tests do not offer as many cacheable operations for the OS. As a result, more data spills into the controller's cache, and the extra 16MB has a significant effect.

ZD CPUmark₃₂ Most of these PCs have a very similar base: The 256K L2 cache model of the Pentium Pro and the newer 440FX chip set from Intel. (Only six systems used different chip sets.) That leaves only the memory type and memory timings for the vendors to tweak to boost performance. These similarities led to a tight grouping of CPUmark₃₂ results, with only a 15 percent variance in scores.

ZD CD-ROM WinMark 97 and multimedia tests For video tests under Windows NT 4.0, we used a clip authored at 900 KBps and a 160-by-120 clip that scales up to full screen (1,024-by-768). In general, systems with Matrox MGA Millennium graphics cards dropped the fewest frames in both clips.

The last time we tested Pentium Pro PCs with Windows NT 3.51 ("Pentium Pro PCs: Power to the People" September 24, 1996) we saw that Windows NT 3.51 is not the platform of choice for video. Windows NT 3.51 did not support DCI, Direct Draw, or Direct Sound. Without these extensions, communication between the hardware and software is nonexistent. Windows NT 4.0 addresses some of these problems by moving many of the APIs into the kernel, specifically a new area called the Win32K. The Win32K contains the window manager, the GDI, and the graphics device drivers that render screen and printer output. Being in the kernel lets the graphics and video hardware avoid performance-sapping context switching when performing function calls to the GDI.

The results of our multimedia tests under Windows NT 4.0 reflect an improvement over Windows NT 3.51 (lower CPU utilization and fewer dropped frames). But Windows NT 4.0 is still not as adept as Windows 95. Windows NT 4.0 needs two things to achieve better video performance: First, the OS needs graphics drivers; and second, NT needs support for the DirectX multimedia software advances that are in Windows 95. DirectDraw, DirectInput, DirectPlay, and DirectSound APIs are promised for Windows NT 4.0 but will not be implemented until 1997.—*Analysis written by Richard Fisco*

How We Tested

We tested all systems with 1.6GB or larger hard disks, 4X or faster CD-ROM drives, and 32MB of RAM. We used Microsoft-supplied Windows NT 4.0 graphics drivers for 1,024-by-768 resolution with 64K colors, small fonts, and a refresh rate of 75 Hz.

We used our **Winstone 97, Version 1.0**, benchmark test suite to measure system performance when running 32-bit applications. Winstone 97 is divided into two categories: ZD Business Winstone 97, focusing on mainstream applications, and ZD High-End Winstone 97, which emphasizes CPU- and graphics-intensive applications. **Business Winstone** measures the time a PC takes to execute a set of application scripts that exercise eight best-selling applications; it then weights a given PC's test timings based on the applications' unit market shares. It derives a composite number and converts it to a relative score. (The score is relative to the performance of a Gateway 486DX2/66 with 16MB of RAM, whose score is defined as 10.) Our **High-End Winstone** tests measure the time a PC takes to execute a set of application scripts that exercise six applications in four different categories: CAD, applications development, image editing, and 3-D visualization. These

continues



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BENCHMARK TESTS

continued

tests weight a given machine's six timings equally, derive a composite number, and convert this number to a relative score. (The score is relative to the performance of a Dell Pentium/100 system with 32MB of RAM, whose score is defined as 10.)

The **ZD Business Graphics WinMark 97** score, a number based on a log of GDI operations used in the Business Winstone suite, represents performance of each machine's graphics subsystem. Scores are normalized to reflect performance relative to the base system used for Business Winstone testing. The **ZD High-End Graphics WinMark 97** score is based on a log of GDI operations used in the High-End Winstone

97 suite and reflects performance of each machine's graphics subsystem. Scores here are also normalized to reflect performance relative to the base system used for High-End Winstone testing. The **ZD Business Disk WinMark 97** score, based on a log of disk functions used in the Business Winstone suite, represents the performance of each machine's disk subsystem. The **ZD High-End Disk WinMark 97** score, based on a log of disk functions used in the High-End Winstone test suite (and weighted in the same manner), reflects the performance of each machine's disk subsystem under Windows NT 4.0.

The ZD CPUmark₃₂ scores reflect the speed of a PC's processor subsystem—which includes the CPU, secondary cache, and system

▲ Higher scores represent better performance.
▼ Lower scores represent better performance.
Bold type denotes first place.

	ZD Business Winstone 97 Score	ZD High-End Winstone 97 Score	ZD Business Graphics WinMark 97 Score	ZD High-End Graphics WinMark 97 Score	ZD Business Disk WinMark 97 Thousands of bytes/sec
Aberdeen Dual Pro 200	57	19	91.8	23.9	852
AcerPower Pentium Pro	53	18	86.6	22.9	848
ACMA zPower Pro 200	48	15	86.7	28.2	628
Advanced Logic Research Evolution Dual/200	44	14	60.9	20.5	632
All Computer Technology P6-200BA	54	18	85.8	24.9	678
AST Bravo MS-T 6200	53	18	86.6	28.2	877
CompuTrend Premio FX Pro200	53	17	68.8	15.7	774
CyberMax ProMax 3-P200	56	19	88.9	28.3	711
Dell Dimension XPS Pro200n	54	18	85.1	25.0	804
Dell OptiPlex GXpro 200	52	17	88.6	38.7	674
DirectWave Blue Thunder PN200 MVP6 ProS	57	18	90.6	27.7	823
DTK Apri-31M/P200	57	19	81.4	21.7	905
EPS Evolution XL-Pro200	52	17	80.5	22.3	688
Everex StepStation Pro	57	19	89.2	28.2	868
Gateway 2000 G6-200	50	17	87.4	28.1	642
HP Vectra VA 6/200 MT	52	17	84.7	27.2	898
HP Vectra XU 6/200	58	19	83.2	24.7	708
Hymco Mercury-200	51	17	64.9	22.8	745
IBM PC 385	53	17	86.8	28.0	808
Maximus Magna Artist ProMedia	55	18	83.7	24.3	830
Mega Double Impact Pentium Pro 200+	56	18	88.9	28.1	821
Micro Express MicroFlex-PCI/Pro200	53	18	90.5	28.6	681
Micron Millennia Pro 2 200 Plus	58	19	88.0	25.3	872
MidWest Micro Office Pro 200	55	18	85.7	25.0	816
Mitsuba Premier-Pro 200	57	19	89.3	28.6	758
Multiwave Pro Power	48	15	82.6	24.7	670
NEC PowerMate Pro2200	54	18	87.0	28.1	751
Polywell Poly Dual P6-200ND2	58	19	92.4	28.7	905
ProGen Nova II Pro200	51	16	87.8	28.0	669
Quantex QP6/200 WS-2	56	19	89.0	28.3	758
Reason Square 6 NA/VA	57	19	89.2	28.2	782
Robotech Cobra XLP/200	52	17	88.0	25.0	697
SAG STA Dual P6	53	19	85.7	23.2	863
Sys Performance Pro 200	58	20	90.7	28.6	908
Tagram Thunderbolt Pro Media	53	16	81.8	19.9	968
Tangent Hurricane Pentium Pro	47	15	85.2	26.8	671
Unisys Aquanta DM/6	46	14	68.8	12.6	774
Unitek UT-P200N Shadow	48	16	81.5	24.6	627
Xi Pro200 MTower SP	58	20	90.1	27.0	933
Zenon Optima Pro Server	61	20	89.2	27.8	1,380

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(1) With an Action, Indeo, 160-by-120, 30-fps, 300-KBps clip scaled to full screen (1,024-by-768) (2) With an Action, Cinepak, 640-by-480, 30-fps, 900-KBps clip

RAM—under a 32-bit operating system.

The **ZD CD-ROM WinMark 97** tests gauge the performance of the machines' CD-ROM subsystem. The tests are based on a profile of six of today's most popular Windows CD-ROMs. We report the results of the **CD-ROM Sequential 16K Read** test, which measures the throughput of the CD-ROM subsystem as it reads 16K blocks of data on a CD-ROM. The **CD-ROM Access Time** score measures CD-ROM drive performance as it randomly accesses 2K blocks from the entire CD-ROM. The **CD-ROM CPU Utilization** score represents the percentage of the processor's bandwidth occupied by servicing the CD-ROM subsystem as it retrieves data. To determine the utilization, WinBench 97

uses a default block size of 16K. The transfer rate defaults to the maximum rate of your particular CD-ROM subsystem. WinBench 97 then calculates this transfer rate before it runs the actual test.

WinBench 97 also includes a suite of video clips that measure a PC's ability to play full-motion .AVI files. We test video playback performance with two types of clips at a variety of data and frame rates, using either an Indeo or a Cinepak codec. We report results from the **Full-Screen Scaling** tests, which uses an Action Indeo, 160-by-120, 30-fps, 300-KBps clip, and the **High-Quality Action Cinepak** tests, which use a Cinepak, 640-by-480, 30-frame-per-second, 900-KBps video clip.

ZD High-End Disk WinMark 97			ZD CD-ROM WinMark 97			CD-ROM			Full-Screen Scaling ¹			High-Quality Action Cinepak ²		
Thousands of bytes/sec		ZD CPUmark ₃₂ Score	Score		Sequential 16K Read (KBps) ▲	Access Time (ms) ▼	CPU Utilization ▼		Frames Dropped ▼	CPU Utilization ▼		Frames Dropped ▼	CPU Utilization ▼	
2,310		550	956		1,190	134	54%		2	35%		93	82%	
2,160		557	772		1,170	182	40%		21	44%		1	81%	
1,420		556	960		1,220	133	38%		3	36%		83	77%	
1,300		553	492		612	217	33%		29	47%		430	51%	
1,890		556	691		1,290	183	5%		152	93%		86	87%	
1,750		560	751		917	158	29%		20	33%		308	67%	
2,120		538	848		1,220	163	58%		331	95%		381	97%	
1,910		563	806		1,020	151	3%		12	27%		388	38%	
1,930		552	858		1,220	157	37%		162	95%		146	97%	
1,870		554	713		1,210	164	38%		83	90%		9	77%	
2,210		560	965		1,220	132	54%		5	45%		349	86%	
2,220		557	685		917	194	3%		157	91%		365	41%	
1,690		554	771		1,070	171	48%		200	88%		361	81%	
2,120		556	961		1,200	131	54%		4	37%		25	83%	
1,570		556	952		1,220	138	58%		5	40%		386	85%	
1,800		559	860		1,220	154	59%		21	37%		0	87%	
2,400		548	496		612	243	2%		4	27%		430	29%	
1,860		559	957		1,190	133	58%		12	48%		353	86%	
1,910		561	863		1,220	153	37%		18	35%		1	77%	
2,220		542	954		1,220	124	5%		186	93%		207	87%	
2,170		552	815		1,020	144	4%		11	27%		362	39%	
1,760		564	839		1,220	165	54%		7	34%		0	83%	
2,500		565	937		1,220	125	4%		158	92%		81	87%	
1,940		559	950		1,520	151	48%		230	81%		223	94%	
2,010		564	981		1,220	133	54%		7	37%		0	82%	
1,580		508	850		1,200	159	49%		23	38%		422	62%	
1,920		558	763		1,210	150	39%		21	33%		2	71%	
2,440		551	954		1,200	137	37%		5	31%		25	70%	
1,480		559	701		1,290	241	46%		11	35%		25	77%	
1,820		561	818		1,020	146	3%		13	27%		370	39%	
2,320		559	684		916	187	28%		5	35%		306	78%	
1,760		558	885		1,250	180	38%		216	83%		203	96%	
2,380		538	840		1,220	171	38%		203	94%		302	97%	
2,270		571	926		1,220	145	54%		12	36%		0	82%	
1,890		531	836		1,230	141	5%		1	61%		423	53%	
1,560		546	945		1,200	139	38%		83	40%		355	74%	
1,530		525	825		1,230	163	5%		408	89%		429	53%	
1,570		489	657		916	185	50%		32	73%		427	66%	
2,530		540	954		1,200	133	58%		4	45%		353	86%	
2,100		538	653		917	190	3%		6	28%		353	43%	

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THERE IS A VOICE INSIDE YOU THAT QUESTIONS
STATUS QUO.

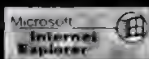
AND YEARNS TO ABANDON THE WAYS
OF TRADITIONAL THINKING.

IT URGES YOU NOT TO BE CONTROLLED BY
YOUR ENVIRONMENT. BUT RATHER,

LET THE ENVIRONMENT ADAPT TO YOU.

THE VOICE INSIDE WHISPERS
FOR YOU TO START DOING EXTRAORDINARY THINGS.

START
DOING
EXTRAORDINARY
THINGS



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To prevent circumstances or surroundings from getting in your way, we created the new TravelMate® 6000 series. An unprecedented 6-way modular bay delivers optimum storage and mem-

ory capabilities, thus offering greater flexibility to work when and where you choose. With a trim 5.9 lb. frame illuminated by a noticeably brighter, more energy-efficient screen, it's ideally suited to even the most unusual locations. The TravelMate 6000 series is also fully supported by our new line of livegear™ accessories, including a wide range of optional docking stations.

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 **TEXAS
INSTRUMENTS**

EIZO NANAO WINS AGAIN!

Back To Back Nod For Monitor Maker

By Rex O. Loeshum
MONITOR STAFF WRITER

LOS ANGELES — It's an announcement that is becoming all too familiar. EIZO Nanao Technologies has once again taken home the coveted Editor's Choice Award from PC Magazine.

This sixth award in the past six years goes to the company's FlexScan® TX-C7S 17-inch class color monitor. It's an honor that carries particular significance as it cites superiority in the judging category having the toughest standards.

"The TX-C7S monitor's image was especially sharp and clear, with no detachable faults," said a PC Magazine judge.

Not too surprising for EIZO, though. The company's monitors previously earned Editor's Choice



October 8, 1996
FlexScan TX-C7S

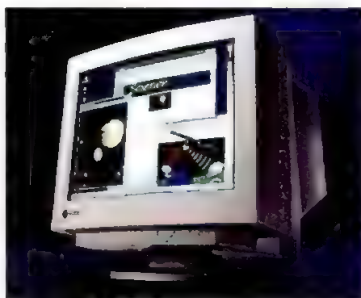
accolades in 1990, 1992, 1993— for its FlexScan 9400, F550iW and FlexScan F340iW monitors—and last year for its highly regarded FlexScan T2-17TS model.

TX-C7S Lauded as 'Best of the Best'

By E.Z. Viewlin
MONITOR STAFF WRITER

LOS ANGELES—Words such as "unbeatable," and "top flight," have been flying around town ever since EIZO Nanao's FlexScan TX-C7S 17-inch class color monitor walked off with the 1996 PC Magazine Editor's Choice Award.

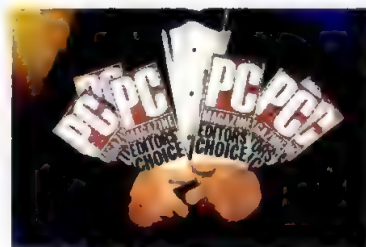
With this key award under its belt, the FlexScan TX-C7S figures to be the monitor of choice for graphics and business professionals who demand crisp, true-to-life colors and stable screen images



This year's big winner: The FlexScan TX-C7S 17-inch class color monitor.

for desktop publishing, 24-bit imagery, high-end graphics and multimedia applications.

Editor's Choice: The Award That Shapes Industry Thinking



It's *deja vu* all over again: EIZO Nanao has now won six Editor's Choice Awards in six years.

By Mona Turr
MONITOR STAFF WRITER

LOS ANGELES—Winning a PC Magazine Editor's Choice Award tells the world of hungry hardware buyers that you've arrived in a big way.

"It's the one award we all dream about, the one we covet more than any other," said N.V.S. Guy of Silicon Valley's LuzerCom.

EIZO Nanao monitors have earned worldwide recognition for dependability, cost-effective performance and pleasing, ergonomic design. In fact, I'm going to stop writing this story right now so I can call EIZO Nanao Technologies at 1-800-800-5202. Then again, I could get an informational fax on demand by calling 1-800-416-FLEX. Either way, like the TX-C7S, I'm a winner.



EIZO is Nanao's New Universal Brand Name
EIZO Nanao Technologies Inc., 5710 Warland Dr., Cypress, CA
90630 Web Site: <http://www.eizo.co.jp/welcom>

Come See Us at Comdex Fall Booth #L142

DTK Computer Inc. **DTK Apri-31M/P200**

The DTK Apri-31M/P200 mid-tower (\$4,200 street), aimed at high-end corporate users, offers some impressive components and yielded strong disk performance on our benchmark tests. DTK Computer also markets a number of other desktop lines, including its value-priced Complete Basic Systems, its Grafika line of performance Pentium workstations, and its Barebones line of basic PCs.

The Apri's Seagate 2.1GB Fast/Wide SCSI-2 hard disk helped it earn an above-average Disk WinMark 97 score and pulled its High-End Winstone 97 score to above average as well. But graphics performance was weak: The Number Nine Imagine 128 Series II graphics board posted a below-average score on our High-End Graphics WinMark 97 test. And because the unit's TEAC 6X SCSI-II CD-ROM drive could not compete with faster models in this roundup, its CD-ROM WinMark 97 score fell below average.

The Apri has a Creative Labs Sound Blaster 16 sound board (FM and wavetable synthesis), JUSTer bookshelf speakers, and a 17-inch ADI monitor; an illustrated system manual comes with it.

A good hard disk buoys the Apri-31M, but the system's price is a bit high compared with that of similarly equipped PCs reviewed here.—*RSA*

DTK Apri-31M/P200. Street price: \$4,200. DTK Computer Inc., City of Industry, CA; 800-289-2385, 818-810-0098; fax, 818-810-0090; www.dtkcomputer.com. Circle 455 on reader service card.

EPS Technologies Inc. **EPS Evolution XL-Pro200**

If you ever need to service the EPS Evolution XL-Pro200 (\$2,995 direct), you'll appreciate its slide-out motherboard and neat interior design. The unit was a decent performer overall, posting a Winstone 97 score on a par with those of the competition. EPS offers a full line of business-oriented Evolution workstations and Apex notebooks.

The Evolution XL-Pro200 is housed in a mini-tower case with a single-CPU EPS motherboard. The motherboard slides out easily—with all expansion cards in place—after you remove a few screws. The unit's components include a comparatively small 1.6GB Quantum Sirocco hard disk, a Number Nine Imagine 128 graphics card, a Hitachi 8X CD-ROM drive, and an Intel Fast Ethernet adapter.

The system's great multimedia-oriented peripherals include a 17-inch CTX monitor, an Ensoniq Soundscape 16-bit wavetable sound card, and two Labtec speakers with Spatializer 3-D sound. Microsoft Office Professional for Windows 95 is bundled.

The Evolution XL-Pro200 posted an average result on our High-End Winstone 97 test, but the system logged below-average scores on the High-End Disk WinMark 97 and High-End Graphics WinMark 97 tests (the latter result was among the lowest in this roundup).

The Evolution XL-Pro200 gains points for easy servicing; newer graphics drivers should boost graphics performance.—*RSA*
EPS Evolution XL-Pro200. Direct price: \$2,995. EPS Technologies

Inc., Jefferson, SD; 800-447-0921, 605-966-5586; fax, 605-966-5482; www.epstech.com. Circle 456 on reader service card.

Everex Systems Inc. **StepStation Pro**

The StepStation Pro (\$3,600) offers great performance and a useful software bundle for a very competitive price. It also has a DMI-compliant design, with a MIF browser included. Everex manufactures a wide range of PCs and notebooks—from the entry-level AMD 5K86-P90-based Explora desktop to the quad-processor Everex STEP QP/Pro Pentium Pro server. The StepStation Pro is part of the company's line of single- and dual-processor workstations, which are sold through resellers.

The StepStation Pro mid-tower system was configured with a Seagate 2GB hard disk, a Toshiba 8X CD-ROM drive, a Matrox MGA Millennium graphics card with 4MB of WRAM, a Creative Labs Sound Blaster 16 wavetable sound card and an Everex Speedlink Fast Ethernet card. The unit uses a single-CPU, ATX-style FIC motherboard. The package also includes a 17-inch Shamrock monitor.

The unit performed well on our benchmark tests, logging above-average scores on our High-End Winstone 97, High-End Graphics WinMark 97, and CD-ROM WinMark 97 tests. Its remaining test scores were average.

The StepStation Pro also features a bundle of useful Microsoft titles, including Works for Windows 95, Encarta 96, Money, Entertainment Pack and Scenes.

The StepStation Pro is a good bet for demanding workstation users with its top-level performance and software bundle.—*RSA*
StepStation Pro. Street price: \$3,600. Everex Systems Inc., Fremont, CA. 800-383-7391, 510-498-1111; fax, 510-683-2240. www.everex.com. Circle 505 on reader service card.

Gateway 2000 Inc. **Gateway G6-200 FPC**

The Gateway G6-200 FPC (\$3,437 direct), a competitive system in terms of performance, represents the top of Gateway 2000's Pentium Pro workstation line. Gateway also offers a full line of home PCs, workstations, and notebooks, which it sells direct. Only its PC-based Destination home entertainment system is sold through retail stores.

Inside the spacious tower case is a single-CPU motherboard, a Seagate 2GB Ultra SCSI hard disk, a Toshiba 8X ATAPI CD-ROM drive, and a Matrox MGA Millennium graphics board. The monitor is a 17-inch Sony Vivitron model.

Multimedia components include a Creative Labs Sound Blaster 16 FM synthesis sound card and a set of Altec Lansing ACS40 speakers with a subwoofer. Microsoft Office for Windows 95 is also included.

Benchmark test scores were above average on our High-End Graphics WinMark 97 and CD-ROM WinMark tests and average on High-End Winstone 97. The High-End Disk WinMark 97 test score was below average, however.

Gateway provides superior illustrated system manuals, an emergency system disk, a system-restore CD-ROM, and round-the-clock technical support. The G6-200 FPC is a well-rounded

package that should satisfy most users.—RSA

G6-200 FPC. Direct price: \$3,437. Gateway 2000 Inc., North Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023; www.gw2k.com. Circle 457 on reader service card.

Hewlett-Packard Co. **HP Vectra VA 6/200 MT,**

HP Vectra XU 6/200

Hewlett-Packard Co. is a strong leader on the Pentium Pro platform, and the two tested units show why. The HP Vectra VA 6/200 MT (\$4,290 street as tested with two 1.2GB hard disks, or \$3,993 with one 2.5GB disk by the time you read this) offers great value for its target market of mainstream corporate users who want a powerful, no-frills Pentium Pro PC. The HP Vectra XU 6/200 (\$5,580 street) boasts a Fast SCSI-2 hard disk, an on-board Adaptec controller, and a 10/100-Mbps Ethernet card for networked power users who want no-compromise performance. Both Vectras are DMI-compliant, but they lack MIF browsers.

The VA 6/200 MT posted average scores on all tests, thanks to its HP motherboard and Intel 440FX chip set. The XU's dual-CPU HP motherboard used standard DRAM, but the system supports a 128-bit memory path for increased throughput. The unit earned top Business Winstone and High-End Disk WinMark scores. Because of its 4X CD-ROM drive, the XU posted a below-average CD-ROM WinMark score, however.

You can pay less for a Pentium Pro system, but you'll be hard-pressed to find another company with higher-quality PCs.—Bruce Brown

Hymco Technologies Inc. **Mercury-200**

The Mercury-200 mid-tower PC (\$2,995 direct) offers great CD-ROM performance with its 8X Toshiba drive and a competent array of multimedia components. Hymco Technologies sells both complete and made-to-order PCs, as well as motherboards, hard disks, network products, and other PC hardware. The Mercury-200 is part of the vendor's newest line of Pentium Pro workstations. Hymco also offers the User series of Pentium desktops and the Minotaur line of Pentium Pro-based workstations.

The Mercury-200 uses a single-CPU, ATX-style motherboard

with Intel's 440FX chip set. The unit came with a Quantum 2.1GB Fast/Wide SCSI-2 hard disk but should be shipping with an IBM 2GB SCSI-3 disk by the time you read this. Other internal hardware includes a Toshiba 8X CD-ROM drive, a Diamond Stealth64 Video VRAM graphics board, and an Audician FM synthesis sound board. The package also features a 17-inch Acer monitor and Altec Lansing bookshelf speakers but lacked a user manual. No application software was bundled with the unit.

The Mercury-200 posted average High-End Winstone 97 and High-End Disk WinMark 97 scores but a below-average High-End Graphics WinMark score. Its CD-ROM WinMark 97 score was one of the highest in this roundup, however.

The Mercury-200 comes well equipped, and sells for a very reasonable price.—RSA

IBM Personal Computer Co. **IBM PC 365**

IBM Personal Computer Co. has three models in its IBM PC 365 line. We tested the one intended for the CAD, financial modeling, and 3-D applications markets (\$4,650 street). The PC 365 is a great pick for a networked corporate environment, being one of only a few PCs here that are fully DMI-enabled, MIF browser and all. The other two variations are an entry-level system and a full-blown graphics workstation. All have dual-processor motherboards but differ in memory, hard disks, and graphics boards.

The tested system's IBM motherboard uses EDO/ECC DRAM and features one USB port, two processor sockets, and Fast Infrared support. (A receiver kit is a \$79 option.) The PC 365 posted good overall test scores and, on the High-End Graphics WinMark tests, garnered a standout above-average score. It was particularly strong on the full-motion video tests, with low frame-drop rates and moderate to good CPU utilization percentages.

IBM also includes its NetFinity client software, which lets network administrators monitor system resources over the network. Add an IBM Wake-On-LAN network card (\$120) and you can remotely turn on a PC for maintenance and software updates. CoSession, Lotus SmartSuite 96, and QA Plus are also included.

The IBM PC 365 is a strong performer with great components and significant vendor support. It will definitely be an asset to your LAN.—BB



HP Vectra VA 6/200 MT. Street price: \$4,290. **HP Vectra XU 6/200.** Street price: \$5,580. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900; www.hp.com. Circle 458 on reader service card.



Mercury-200. Direct price: \$2,995. Hymco Technologies Inc., San Jose, CA; 800-884-9626, 408-251-6888; fax, 408-251-2333; www.hymco.com. Circle 459 on reader service card.



IBM PC 365. Street price: \$4,650. IBM Personal Computer Co., Armonk, NY; 800-426-4968; fax, 800-426-4329; www.pc.ibm.com. Circle 460 on reader service card.

Maximus Computers Inc. **Magna Artist ProMedia**

With the Magna Artist ProMedia (\$3,999 direct) from Maximus Computers, you get a good power business machine with mostly average performance. The Magna Artist ProMedia is at the top of the business-oriented ProMedia series.

The unit offers a dual-CPU motherboard—an attractive feature for forward-thinking business owners. Hardware includes a Creative Labs Sound Blaster AWE32 wavetable sound card, a 28.8/14.4-Kbps data/fax/voice modem, an 8X CD-ROM drive, a Number Nine Imagine 128 Series II graphics board, a 17-inch monitor, and JUSTer speakers. The unit also came with a 2GB Fast/Wide SCSI-2 hard disk paired with an Adaptec Ultra-Wide controller. A small bundle of productivity and communications software includes Microsoft Office Professional for Windows 95.

The system did well on most of our tests, especially on our Disk WinMark 97 and CD-ROM WinMark 97 tests, where it posted above-average scores. Its High-End Graphics WinMark 97 score was below average, however.

The Magna Artist ProMedia provides strong multimedia hardware, and its extra processor socket adds substantially to its usable life.—RSA

Magna Artist ProMedia. Direct price: \$3,999. Maximus Computers Inc., Monrovia, CA; 800-888-6294, 818-305-5925; fax, 818-357-9140; www.maximuspc.com. Circle 483 on reader service card.

Mega Computer Systems **Double Impact Pentium Pro 200+**

With its huge tower case and top-quality peripherals, plus an included Ethernet card, Mega Computer Systems' Double Impact Pentium Pro 200+ (\$3,995 direct) is a good bet for buyers looking for system speed and space to grow. Mega targets a broad audience with this strong performer, from small businesses to Fortune 1000 corporations.

The Super Micro motherboard in the Mega system uses the Intel 440FX chip set and EDO DRAM. The motherboard also boasts USB support as well as two processor sockets. Audio is covered by a Creative Labs Sound Blaster AWE32 sound card with wavetable and FM synthesis, plus Kingtex speakers. A

33.6/14.4-Kbps modem is also included with the system, as are a 6.7X Toshiba CD-ROM drive and a high-quality 17-inch Iiyama monitor.

All of the test scores met or exceeded the averages for this roundup, underscoring the system's versatility as well as its well-rounded mixture of components. A 2GB Fast/Wide SCSI-2 hard disk paired with an Adaptec controller helped yield an above-average Disk WinMark score. The system also employs a Matrox MGA Millennium graphics adapter, which helped it achieve an above-average score on our Graphics WinMark tests.

With plenty of room for expansion and strong, even performance, the tested unit is impressive and worthy of consideration for a variety of business purposes.—BB

Micro Express **MicroFlex-PCI/Pro200**

Boasting high-performance computing for a low cost, the MicroFlex-PCI/Pro200 (\$2,699 direct) is sure to catch the eyes of power-seekers who are looking to save money. Although Micro Express originally intended to target this system at business users, it now targets all buyers looking for power at a low price, whether they want to run Microsoft Windows 95 or Windows NT.

Micro Express uses its own motherboard in the MicroFlex, with Intel's 440FX chip set and EDO DRAM. On our benchmark tests, the system's scores were mostly on a par with those of other units. The exception was an above-average score on the Graphics WinMark 97 test, thanks to the unit's Matrox MGA Millennium graphics card, which is plugged into a fine Princeton 17-inch monitor.

Disk storage is plentiful with a Quantum Sirocco 2.5GB Fast ATA-2 hard disk, and multimedia needs are met by a Sony 8X CD-ROM drive, a Creative Labs wavetable audio card, and Sound Land speakers.

The MicroFlex is not the fastest system we tested, nor is it the most expandable. What you get with Micro Express's Pentium Pro-based machine is just what the vendor promises: speedy performance on the latest platform at an attractive price.—BB



Double Impact Pentium Pro 200+. Direct price: \$3,995. Mega Computer Systems, San Diego, CA; 800-338-6628; fax, 619-485-1518; www.megacs.com. Circle 461 on reader service card.

MicroFlex-PCI/Pro200. Direct price: \$2,699. Micro Express, Irvine, CA; 800-989-9900, 714-852-1400; fax, 714-852-1225; www.wpages.com/microexpress/. Circle 462 on reader service card.

Millennia Pro 200 Plus. Direct price: \$4,548. Micron Electronics Inc., Nampa, ID; 800-388-6334, 208-893-3434; fax, 208-893-3424; www.mei.micron.com. Circle 463 on reader service card.

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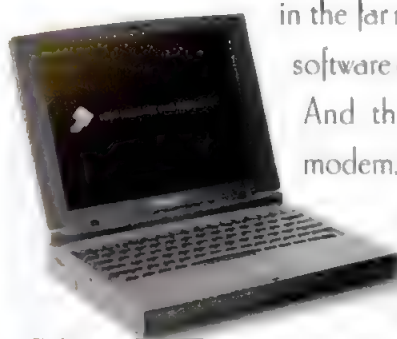


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*Estimated street price. Dealer prices may vary. ©1996 Hitachi PC Corporation (USA). All rights reserved. The Hitachi E Series, Mobilized Computing and Remote Control are trademarks of Hitachi PC Corporation (USA) which may be registered in some jurisdictions. The Intel Inside Logo and Pentium are registered trademarks of Intel Corporation. All other marks are owned by their respective companies.

Remote Control

CIRCLE 082 ON READER SERVICE CARD

Micron Electronics Inc. **Millennia Pro 2 200 Plus**

Originally designed as a CAD-CAM workstation but now targeted as a general-purpose power-user system, Micron Electronics' Millennia Pro 2 200 Plus (\$4,548 direct) is a top performer that's ready for even higher performance levels if you add a second CPU to its dual-socket motherboard. There is no skimping: From the hard disk to the sound system, this PC is ready for serious work.

Micron uses a Micronics W6LI motherboard with the Intel 440FX chip set and EDO DRAM. The hard disk is a very big, fast Seagate 4GB Ultra SCSI model, hooked to an Adaptec 2940UW controller. This combination excelled on our benchmark tests, helping the unit earn an above-average score on our High-End Winstone 97 and Disk WinMark tests. Top performance was also shown on the CD-ROM WinMark 97 tests, where the unit's Plextor 8X CD-ROM drive helped it achieve another above-average result.

For multimedia applications, the Millennia has an integrated Vibra 16CL audio chip set and Advent AV270 powered speakers. The system also comes preloaded with Microsoft Office Professional 95.

Fast performance, good service policies, and the ability to handle another processor (a \$699 upgrade) for even better performance mean that the Micron Millennia Pro 2 200 Plus is ready to deliver, both now and in the future.—BB

MidWest Micro **Office Pro 200**

Little things mean a lot, whether you're singing pop songs or pricing PCs. The Office Pro 200 includes a little more disk than average (okay, 1GB more), a little bit faster CD-ROM drive (10X), and a bonus 28.8/14.4-Kbps modem, all at a direct price that's a bit below average (\$3,499). Test performance was also solid.

The bulk of the Office Pro 200 follows the common pattern, starting with Intel's VS440FX motherboard with four 72-pin SIMM sockets that can hold up to 128MB of memory. In order to assuage the fears of those who are new to direct buying, MidWest Micro includes an introductory manual that covers PC basics but fails to mention specific systems or processors—a necessary adjunct, considering the absence of labeling on the multitude of rear-panel connectors. MidWest Micro also throws in a bag of extra drive-mounting hardware for good measure.

The unit produced mostly average test results. Its 10X CD-ROM drive, however, pulled it ahead of the pack on our CD-ROM WinMark 97 tests, and helped it achieve the best Sequential Read score in the roundup.

If you know what you're doing and what you want, you'll get a little bit more from the Office Pro 200.—Winn L. Rosch

Office Pro 200. Direct price: \$3,499. MidWest Micro, Fletcher, OH; 800-728-8582, 513-368-2309; fax, 513-368-2306; www.mwmicro.com. Circle 464 on reader service card.

Mitsuba Corp. **Premier-Pro 200**

Mitsuba Corp.'s \$3,900 (street) Premier-Pro 200, like most of the company's Pentium Pro systems, is sold through VARs, which

sell it mainly as a Windows NT workstation. The Premier-Pro provides a strong base for value-adders building turnkey or custom solutions, with good all-around performance and components.

Thanks to a 2.1GB Fast SCSI hard disk and Adaptec 2940UW controller, along with a Matrox MGA Millennium graphics adapter, the system posted average or above-average results on most of our tests. More specifically, its High-End Winstone 97, Graphics WinMark 97, and CD-ROM WinMark 97 scores were all above this speedy group's averages. The unit was particularly strong on our full-motion video tests, showing low frame-drop rates on both test samples—a boost stemming from Matrox's optimized Windows NT drivers.

The unit also came with an 8X CD-ROM drive, a 17-inch monitor, a Creative Labs 32-bit Sound Blaster wavetable audio card, and JUSTer SP-980 multimedia speakers. These speakers deliver good sound at high volumes without too much distortion and feature a surround-sound switch that actually works.

The Mitsuba system is a fine Pentium Pro platform for a wide range of business applications.—BB

Premier-Pro 200. Street price: \$3,900. Mitsuba Corp., La Verne, CA; 800-648-7822, 909-392-2000; fax, 909-392-2021; www.mitsuba.com. Circle 466 on reader service card.

Multiwave Technology Inc. **Multiwave Pro Power**

Multiwave Technology's Multiwave Pro Power, attractively priced at \$2,705 direct, is intended for general business use. Although the Pro Power has a high-quality chassis and a good overall component mix, its performance on both our High-End and Business Winstone tests was below par.

The Pro Power's center is a 450KX-based Intel Venus motherboard with two USB ports. The system's chassis is well finished on the inside and has a sliding cage that facilitates removal of the motherboard and system cards for maintenance.

On our tests, the unit garnered below-average results on our Winstone tests as well as on the Disk WinMark 97 tests. Its other test scores were average.

Multimedia duties were performed by an 8X CD-ROM drive (the unit now ships with a 10X drive), a Ensoniq audio card, and JUSTer SP-980 speakers. Multiwave also bundles a 33.6/14.4-Kbps data/fax modem with voice mail. We received a home-oriented software bundle with the system, but it now ships with Microsoft Office 95.

In terms of performance, the unit lagged the pack, but otherwise the Pro Power is an adequate PC offered at a low price.—BB

Multiwave Pro Power. Direct price: \$2,705. Multiwave Technology Inc., City of Industry, CA; 800-234-3358; fax, 818-333-4609; www.mwave.com. Circle 484 on reader service card.

NEC Computer Systems **PowerMate Pro2200**

If you work in a connected corporation, NEC Computer Systems wants to put a DMI-compliant PowerMate Pro2200 (\$3,350 street) on your desk. The vendor has packaged its powerful PC with a wealth of software aimed at controlling the tangles in today's wired office—Intel's LANDesk Client Manager, McAfee's virus protection software, MagicEye for securi-

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ty and diagnostics, and Cybermedia's First Aid Plus.

A rare left-handed PC, the PowerMate Pro2200 turns the tables on traditional mini-tower designs, moving the motherboard to the left side of its case and turning its internal layout upside down. The result puts the power supply and drive bays at the bottom, giving easier access to slots, lowering the center of gravity, and making the unit more tip-resistant.

The foundation for the PowerMate Pro2200 is Intel's seven-slot VS440FX motherboard with built-in sound. Two PCI slots are occupied by a Matrox MGA Millennium graphics board and a 3Com 10/100-Mbps Fast Ethernet adapter. The 2.1GB IBM hard disk and NEC 8X CD-ROM drive tie to the on-board four-drive Mode 4 EIDE system. Besides the usual ports, the unit includes two USB connectors and a front-panel, 115-Kbps IrDA sensor.

Performance on our benchmark tests was mostly average. The one exception was an above-average score on our High-End Graphics WinMark 97 test.

Focusing on the case is no left-handed compliment: It's among the most solid we've seen. So are the peripherals, all of which wear the NEC label—a MultiSync M700 monitor and 20-watt, two-way speakers. All will serve well, whether you're connected or not.—WLR

Polywell Computers Inc. Poly Dual P6-200ND2

Polywell Computers' speedy Poly Dual P6-200ND2, rightly intended for CAD-CAM users and for video-editing and Internet development-related work, sells for \$3,788 direct. Based on its enviable test scores, the Polywell PC looks to be a great deal for power-hungry users.

The Poly Dual P6-200ND2 starts with a SuperMicro motherboard featuring two processor sockets and the Intel 440FX chip set. This base helped it attain an above-average High-End Winstone 97 score. The unit also posted an above-average score on the Graphics WinMark 97 tests, a tribute to its Matrox MGA Millennium adapter, and did well on the full-motion video tests. The unit's 4.3GB Fast/Wide SCSI-2 hard disk and Adaptec 2940UW controller came through as well, helping it post high Disk WinMark 97 scores. Thanks to its 8X Toshiba

CD-ROM drive, the unit also posted an above-average score on our CD-ROM WinMark 97 tests. The system's other scores were on our tests average.

The system features a Creative Labs FM synthesis audio card with QuickShot SoundForce 600 powered speakers. Microsoft Office Pro 95 is also bundled.

Polywell has hit its mark well, packaging a system with strong hard disk and graphics performance.—BB

Poly Dual P6-200ND2. Direct price: \$3,788. Polywell Computers Inc., South San Francisco, CA; 800-999-6649; fax, 415-583-1975; www.polywell.com. Circle 468 on reader service card.

ProGen Systems Nova II Pro200

ProGen Systems' Nova II Pro200 (\$3,049 direct) is targeted at high-end professional users, especially graphics designers. The unit is priced well given its components and software, but its performance lagged behind that of many systems because of a slow hard disk.

Most of the Nova II's components are of top-notch quality, from its Intel motherboard with the Intel 440FX chip set to its Matrox MGA Millennium graphics adapter and 17-inch MAG monitor. The graphics card helped the unit post an above-average Graphics WinMark 97 score. The weak link in this system is its 5,200-rpm 2.4GB hard disk, which could not compete with the faster devices we found in other systems and held the Nova II to below-average scores on our disk and High-End Winstone tests.

The Nova II's audio complement is very good and includes a Creative Labs Sound Blaster 32 PnP wavetable audio card and MIDI Land MLi-D2 speakers, which provide surprisingly good sound quality for their small size. Despite a 10X CD-ROM drive (12X will be standard by the time you read this), the unit had a below-average CD-ROM WinMark 97 score. ProGen also bundles a 33.6/14.4-Kbps modem, which will be upgraded to include voice mail by the time you read this, as well as Microsoft Office Pro for Windows 95.

Though hampered by the hard disk in our test configuration, with a faster disk the Nova II Pro200 should deliver good performance at a competitive price.—BB



PowerMate Pro2200. Street price: \$3,350. NEC Computer Systems, Boxborough, MA; 800-632-4636, 508-264-8000; fax, 800-366-0476; www.nec.com. Circle 467 on reader service card.

Nova II Pro200. Direct price: \$3,049. ProGen Systems, Tustin, CA; 800-848-1353, 714-566-9200; fax, 714-566-9267; www.progen.com. Circle 469 on reader service card.

QP6/200 WS-2. Direct price: \$3,049. Quantex Microsystems, Somerset, NJ; 800-760-9001, 908-563-4166; fax, 908-563-0407; www.quantex.com. Circle 470 on reader service card.

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SUMMARY OF FEATURES

Pentium Pro PCs

■ YES ■ NO

In alphabetical order by company

	Aberdeen Deal Pro 200	AcerPower Pentium Pro	ACMA zPower Pro 200	Advanced Logic Research Evolution Dual6/280	All Computer Technology P6-2008A	AST Bravo MS-T 6208	CompuTrend Premio FX Pro200
Price of tested configuration	\$3,900 (street)	\$3,700 (street)	\$3,295 (direct)	\$3,910 (street)	\$3,788 (direct)	\$2,860 (street)	\$3,500 (street)
Installed RAM and type	32MB	32MB EDO	32MB EDO	32MB	32MB EDO	32MB EDO	32MB EDO
Hard disk	Quantum Atlas XP34300W	Seagate Barracuda ST32550W	Seagate Medalist ST32140A	Western Digital Caviar AC31600	Seagate Hawk ST32155W	Western Digital Caviar 32500	Quantum Atlas XP32150W
Capacity and interface	4GB Fast/Wide SCSI-2	2GB Fast/Wide SCSI-2	2GB Fast ATA-2	1.5GB EIDE	2GB Ultra SCSI	2.1GB EIDE	2.1GB Fast/Wide SCSI-2
Graphics adapter	Matrox MGA Millennium	Diamond Stealth64 Video VRAM 3240	Matrox MGA Millennium	Diamond Stealth64 Video VRAM 3240	Number Nine Imagine 128 Series II	Matrox MGA Millennium	Number Nine Imagine 128
Memory	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM
Monitor (and screen diagonal claimed/ measured, in inches)	KDS VSX-7 (17, 15.5)	AcerView 76ie (17, 15.8)	Impression Vienna 17 (17, 16)	MAG InnoVision DX1795 (17, 16.3)	MAG InnoVision DX1795 (17, 16.3)	AST Vision 17L (17, 15.8)	Premio H1767 (17, 15.5)
CD-ROM drive (speed and interface)	Toshiba XM-5602B (8X ATAPI)	Acer 685A-007 (4X ATAPI)	Toshiba XM-5602B (8X ATAPI)	Sanyo CRD-254P (4X ATAPI)	Nakamachi MJ-4.8s (8X SCSI-2)	Toshiba XM-5522B (8X ATAPI)	Mitsumi CRMC-FX810T (8X ATAPI)
Modem speed (data/fax, in Kbps)	33.6/14.4	N/A	N/A	N/A	33.6/14.4	N/A	N/A
Network adapter	N/A	N/A	N/A	Cogent EM 110 PCI	N/A	N/A	N/A
Motherboard Components							
Motherboard manufacturer	SuperMicro	Acer	Intel	ALR	SuperMicro	Intel	PCI
Chip set	Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82450KX	Intel 82440FX	Intel 82440FX	Intel 82440FX
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■
Expandability							
Maximum RAM	128MB	512MB	256MB	128MB	768MB	128MB	512MB
Expansion-bus slots	4 ISA, 4 PCI	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	4, 0	3, 2	3, 1	3, 1	3, 2	3, 2	3, 2
Internal drive bays (5.25", 3.5")	0, 4	0, 2	0, 1	0, 1	0, 2	0, 2	0, 3
Parallel/serial/mouse ports	1, 3, 1	1, 2, 1	1, 2	1, 2, 1	1, 2, 1	1, 2, 1	1, 1, 1
Service and Support							
24-hour, 7-day live technical support	■	■	■	■	■	■	■
Standard warranty on parts/labor	1 year/1 year	3 years/3 years	3 years/1 year	5 years/3 years	1 year/1 year	3 years/3 years	3 years/2 years
On-site service charge (first year)	\$119.95	Included	Included	\$9.95	\$129.95	Included	\$75.00

N/A—Not applicable: This product does not have this feature.

Quantex Microsystems QP6/200 WS-2

Quantex Microsystems' QP6/200 WS-2 (\$3,049 direct) is sold largely to its target group of small and medium-size businesses with users who run 32-bit applications. Quantex also sells the QP6/200 SM-3 Pentium Pro line with Windows 95 for customers who want the new performance platform but don't yet want to move to Windows NT. A good performer on all our tests, and fully equipped (including one of the best speaker systems around), the QP6/200 WS-2 should definitely please its intended audience.

Quantex uses an Intel P6VI motherboard with the 440FX chip set and EDO DRAM. To this strong base the vendor adds a Seagate 2.1GB Ultra SCSI hard disk with an Adaptec 2940UW controller and a Matrox MGA Millennium graphics card attached to a MAG InnoVision 17-inch monitor. Good scores on all tests show that these components are well matched. The unit had two performance highlights: above-average scores on our High-End Winstone and Graphics WinMark 97 tests.

The QP6/200 WS-2 has better multimedia equipment than many other systems, especially in the audio department. Added

to the Toshiba 6.7X SCSI CD-ROM drive is an Ensoniq Vivo wavetable audio card. The pairing of ACS-400 surround-sound speakers and an ACS-250 subwoofer rounds out the unit and makes for a great speaker combination. Though it may be overkill for a business PC in a conventional office, SOHO users in particular will enjoy the clarity of the speakers' full audio range and the ability to take the loudest coffee break on the block.

This PC makes sense for a variety of businesses, with good performance and very strong multimedia support.—BB

Reason Technology Inc. Square 6 NA/VA

Reason Technology's \$2,995 (direct) Square 6 NA/VA is intended as a mainstream corporate business system. The fairly priced Square 6 NA/VA performs well and should appeal to its intended audience.

Reason bases the Square 6 NA/VA on an Intel Performance/VS motherboard with Intel's 440FX chip set and EDO DRAM. The system posted strong test scores overall, with above-average scores on our High-End Winstone 97 and High-End Disk

COVER STORY
Pentium Pro PCs

Continues

PC MAGAZINE EDITOR'S CHOICE		PC MAGAZINE EDITOR'S CHOICE		DirectWave Blue Thunder PN200 MVP6 Pro S		DTK Agi-31M/P200	EPS Evolution XL-Pro200	Everex StepStation Pro	Gateway G6-200 FPC	HP Vectra VA 6/200 MT
CyberMax ProMax 3-P200	Dell Dimension XPS Pro200n	Dell OptiPlex GXpro 200	Dell OptiPlex GXpro 200	DirectWave Blue Thunder PN200 MVP6 Pro S	DTK Agi-31M/P200	EPS Evolution XL-Pro200	Everex StepStation Pro	Gateway G6-200 FPC	HP Vectra VA 6/200 MT	
\$3,800 (street)	\$3,349 (direct)	\$3,802 (direct)	\$3,399 (direct)	\$4,200 (street)	\$2,995 (direct)	\$3,600 (street)	\$3,129 (direct)	\$4,290 (street)		
32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO
Seagate Hawk ST15230W	IBM Deskstar DAQA-33240	Seagate Medalist ST32140A	Quantum Atlas XP32150W	Seagate Barracuda ST32550W	Quantum Sirocco 1700AT	Seagate Barracuda ST32550W	Seagate Hawk ST32155W	Quantum Fireball 1280AT		
4.3GB Fast/Wide SCSI-2	3GB ATA-3	2GB Fast ATA-2	2.1GB Fast/Wide SCSI-2	2GB Fast/Wide SCSI-2	1.6GB Fast ATA-2	2GB Fast/Wide SCSI-2	2GB Ultra SCSI	Two 1.2GB Fast ATA-2		
Matrox MGA Millennium	Number Nine Imagine 128 Series II	Number Nine Imagine 128 Series II	Matrox MGA Millennium	Number Nine Imagine 128 Series II	Number Nine Imagine 128	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium		
4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM
Princeton Ultra 17+ (17, 16)	Samsung 17LS (17, 15.5)	Dell UltraScan 17LS (17, 15.8)	MAG InnoVision DX1795 (17, 16.3)	ADI Microscan 5v (17, 16)	CTX 1785XA (17, 16.3)	Shamrock SRC- 1703 (17, 16.3)	Sony Vivitron17 (17, 16)	HP Ultra VGA 1280 (17, 15.8)		
Toshiba XM-3701B (8.7X SCSI-2)	Sony CDU311 (8X ATAPI)	NEC CDR-1400A (8X ATAPI)	Toshiba XM-5602B (8X ATAPI)	TEAC CD-56S (6X SCSI-2)	Hitachi CDR-7830 (8X ATAPI)	Toshiba XM-5602B (8X ATAPI)	Toshiba XM-5602B (8X ATAPI)	Hitachi CDR- 7930 (8X ATAPI)		
28.8/14.4	28.8/14.4	N/A	33.6/14.4	N/A	N/A	N/A	28.8/14.4	N/A	N/A	N/A
N/A	N/A	3Com EtherLink III EISA Parallel Tasking	N/A	N/A	Cogent EM110 TX	Everex SpeedLink EUV 2066				
Intel	Intel	Dell	ASUSTek	DTK	BCM	FIC	Intel	Intel	Intel	Hewlett-Packard
Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82430FX	Intel 82440FX	Intel 82440FX	Intel 82440FX
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■	■
256MB	128MB	512MB	256MB	384MB	256MB	512MB	256MB	192MB		
3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 PCI, 2 PCI/ISA	2 ISA, 4 PCI, 1 PCI/ISA	2 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 2 PCI, 1 PCI/ISA		
4, 1	2, 3	2, 1	3, 2	4, 1	3, 2	3, 2	4, 1	3, 1		
0, 2	0, 2	0, 2	0, 1	0, 3	0, 2	0, 2	3, 3	1, 2		
1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	2, 1, 1	1, 2, 1	1, 2, 1		
■	■	■	■	■	■	■	■	■	■	■
3 years/1 year Included	3 years/1 year Included	3 years/1 year Included	3 years/3 years \$33.99	2 years/2 years \$50.00	3 years/1 year Included	3 years/3 years Included	3 years/3 years Included	3 years/3 years Included	3 years/3 years Included	3 years/3 years Included

WinMark 97 tests, thanks to its 2.1GB Fast/Wide SCSI-2 hard disk.

A Matrox MGA Millennium graphics adapter provides fast graphics (the unit garnered an above-average Graphics WinMark 97 score) while its output is handled by a fine 17-inch Samsung display. The unit's 6X CD-ROM drive, Ensoniq wavetable audio card, and Yamaha YST M-10 speakers are more than adequate for business multimedia. However, the 6X drive had difficulty keeping up with the 8X and faster models in this roundup, leading the unit to a below-average CD-ROM WinMark 97 score.

The Square 6 NA/VA is right on target as a worthy mainstream corporate PC that will also serve SOHO users well.—**BB Square 6 NA/VA.** Direct price: \$2,995. Reason Technology Inc., Minneapolis; 800-800-4860, 612-780-4792; fax, 612-780-4797; www.reasontech.com. *Circle 471 on reader service card.*

Robotech Inc. **Cobra XLP/200**

Robotech's Cobra XLP/200 (\$3,999 street) is intended for graphics and small-business applications. The Cobra XLP/200 shows that you can get a lot for your money: It comes

complete with a Fast Ethernet card and a voice modem, and it was a competitive performer.

The unit used an Intel motherboard with the 440FX chip set. It has the same high-quality chassis as Multiwave's entry, with a component subsystem that slides in and out easily—a handy feature for system maintenance. All of the Cobra's benchmark test scores were average.

Robotech's entry features a Creative Labs wavetable audio card, and small Robotech 690H speakers. A 3Com 3C509 PCI Fast Ethernet adapter makes the Cobra network-ready. A 33.6-Kbps DSVD modem with voice mail combined with Intel's ProShare software lets you receive videophone images—add a camera, and you can go two-way if you can handle the slow speeds. Robotech also bundles Microsoft Office Professional 95 and a Microsoft Natural Keyboard with this system.

The Cobra XLP/200's good performance and complete hardware and software bundle make it a worthy purchase.—**BB Cobra XLP/200.** Street price: \$3,999. Robotech Inc., Midvale, UT; 800-255-2215, 801-565-0645; fax, 801-565-0680; www.robotechusa.com. *Circle 472 on reader service card.*

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Echos Pro Notebook Standard Features:

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Echos Pro 150S

150MHz Pentium® processor, 12.1" SVGA TFT display, 2GB Removable HDD

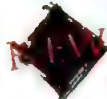
\$4,999*



Echos Pro 133S

133MHz Pentium® processor, 12.1" SVGA TFT display, 2GB Removable HDD

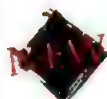
\$3,999*



Echos Pro 133D

133MHz Pentium® processor, 12.1" SVGA DSTN display, 1.3GB Removable HDD

\$3,499*



The optional Echos™ Pro Docking System offers full port replication, Multi-function bay, drive bay, 2 PCI Card slots, plus much more. It's the perfect solution for desktop replacement.



**Echos
P133S**

Echos Notebook Standard Features:

Pentium® processor, PCI Bus, 256K L2 cache, 1.3GB removable HDD, Multi-function bay: 6X CD-ROM and modular FDD (std.), second battery (opt.)

Echos P133S

133MHz Pentium® processor, 16MB RAM expandable to 40MB, 11.8" SVGA TFT display

\$3,499*

Echos P120E

120MHz Pentium® processor, 8MB RAM expandable to 40MB, 11.3" SVGA TFT display

\$2,999*

Echos P100E

100MHz Pentium® processor, 8MB RAM expandable to 40MB, 10.4" SVGA TFT display

\$2,599*

Echos P100C

100MHz Pentium® processor, 8MB RAM expandable to 40MB, 11.3" SVGA DSTN display

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SUMMARY OF FEATURES

Pentium Pro PCs

■ YES ■ NO In alphabetical order by company	HP Vectra XU 6/200	Hynco Mercury-200	IBM PC 365	Maximus Magna Artist ProMedia	Mega Double Impact Pentium Pro 200+	Micro Express MicroFlex- PCI/Pro200	Micron Millennia Pro 2 200 Plus
Price of tested configuration	\$5,580 (street)	\$2,995 (direct)	\$4,650 (street)	\$3,999 (direct)	\$3,995 (direct)	\$2,699 (direct)	\$4,548 (direct)
Installed RAM and type	32MB	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO
Hard disk	Seagate Barracuda ST32550N	IBM Deskstar DORS-32160	IBM Deskstar DAQA-33240	Quantum Atlas XP32150W	Quantum Atlas XP32150W	Quantum Sirocco 2550AT	Seagate Barracuda ST34371N
Capacity and interface	2GB Fast SCSI-2	2GB Fast/Wide SCSI-2	3GB ATA-3	2.1GB Fast/Wide SCSI-2	2.1GB Fast/Wide SCSI-2	2.5GB Fast ATA-2	4GB Ultra SCSI
Graphics adapter	Matrox MGA Millennium	Diamond Stealth64 Video VRAM 3240	Matrox MGA Millennium	Number Nine Imagine 128 Series II	Matrox MGA Millennium	Matrox MGA Millennium	Number Nine Imagine 128 Series II
Memory	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM
Monitor (and screen diagonal claimed/ measured, in inches)	HP Ultra VGA 1280 (17, 15.8)	AcerView 76ie (17, 15.8)	IBM G70 (17, 15.7)	MAG InnoVision DX17T (17, 16.3)	Iiyama MF-6617E (17, 15.6)	Princeton Ultra 17+ (17, 15.8)	ADI LM-1764 (17, 16)
CD-ROM drive (speed and interface)	Sony CDU76S (4X SCSI-2)	Toshiba XM-5602B (8X ATAPI)	Hitachi CDR- 7930 (8X ATAPI)	Plextor PX-83CS (8X SCSI-2)	Toshiba XM-3701B (6.7X SCSI-2)	Sony CDU-311 (8X ATAPI)	Plextor PX-8XCS (8X SCSI-2)
Modem speed (data/fax, in Kbps)	N/A	N/A	N/A	28.8/14.4	33.6/14.4	N/A	N/A
Network adapter	HP 10/100 VG Selectable PCI LAN Adapter	N/A	N/A	N/A	Danpex EN-9400P3	N/A	N/A
Mathematical Components							
Motherboard manufacturer	Hewlett-Packard	Intel	IBM	SuperMicro	SuperMicro	Micro Express	Micronics
Chip set	Intel 82450KX	Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82440FX
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■
Expandability							
Maximum RAM	256MB	128MB	512MB	1GB	1GB	256MB	256MB
Expansion-bus slots	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI/ISA	4 ISA, 4 PCI	4 ISA, 4 PCI	3 ISA, 3 PCI, 1 PCI/ISA	1 ISA, 3 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	3, 2	3, 2	2, 1	5, 0	4, 1	3, 2	2, 3
Internal drive bays (5.25", 3.5")	0, 2	0, 2	0, 2	1, 4	0, 2	0, 2	1, 2
Parallel/serial/mouse ports	1, 2, 1	1, 2, 1	1, 1, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1
Service and Support							
24-hour, 7-day live technical support	■	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/3 years	2 years/1 year	3 years/3 years	4 years/4 years	2 years/2 years	2 years/2 years	3 years/1 year
On-site service charge (first year)	Included	\$100.00	Included	Included	N/A	\$50.00	Included

N/A—Not applicable: The product does not have this feature.

SAG Electronics STA Dual P6

Storage that starts where others leave off—a 4.1GB Seagate Barracuda hard disk with a 40-Mbps Ultra Wide SCSI interface—only hints at what custom-builder SAG Electronics will stuff into its STA Dual P6. Billing itself as a mass-storage expert, SAG believes only storage separates today's Pentium Pro PCs from the likes of RISC systems. Invest more than the \$3,800 direct price of the STA Dual P6, and SAG will add mirroring or a drive array inside the system's roomy case.

The unit's tower gives you seven drive bays in which to house that storage capability. The dual-socket Intel motherboard features nearly everything you need in terms of ports (including one game port, 10/100Base-T networking, and Sound Blaster-compatible audio). The four DIMM sockets can hold up to 512MB of RAM.

The system posted above-average scores on our High-End Winstone 97 and Disk WinMark 97 tests, and solidly average scores on all other tests.

The STA Dual P6 also ships with Intel's LANdesk Client

Manager 3.0, a system management program that tracks a variety of system attributes in tandem with an integrated chip on the motherboard.

The only instructions belong to the Labtec speakers and MAG InnoVision monitor. You've got to know what you're doing to use the STA Dual P6—but then again, you've got to know what you want before you ask to have one built.—WLR
STA Dual P6. Direct price: \$3,800. SAG Electronics, North Andover, MA; 800-989-3475, 508-683-0339; fax, 508-689-0180; www.sagelec.com. Circle 474 on reader service card.

Sys Technology Inc. Sys Performance Pro 200

A special motherboard and cables accent the clean and simple philosophy with which Sys Technology crafts its Sys Performance Pro 200. The \$3,699 (direct price) custom-built PC keeps upgrades simple: You shouldn't need to make any since the box includes just about everything you'll need today, such as 3Com Fast Ethernet adapter and a Creative Labs Sound Blaster 32 audio card. You've got to hope this will remain true well into

COVER STORY
Pentium Pro PCs

Continues

MidWest Micro Office Pro 200	Mitsuba Premier-Pro 200	Multiwave Pro Power	NEC PowerMate Pro2200	Polywell Poly Dual P6-200ND2	ProGen Nova II Pro200	Quantax QP6/200 WS-2	Reason Square 6 NA/VA	Robotech Cobra XLP/200
\$3,499 (direct)	\$3,900 (street)	\$2,705 (direct)	\$3,350 (street)	\$3,788 (direct)	\$3,049 (direct)	\$3,049 (direct)	\$2,995 (direct)	\$4,000 (street)
32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO
IBM Deskstar DAQA-33240	Quantum Atlas XP32150S	Western Digital Caviar 32500	IBM Deskstar DAQA-32160	Quantum Atlas XP34300W	Western Digital Caviar AC32500	Seagate Barracuda ST32550N	Quantum Atlas XP32150W	Western Digital Caviar 32500
3GB ATA-3	2.1GB Fast SCSI-2	2.1GB EIDE	2GB ATA-3	4.3GB Fast/Wide SCSI-2	2.4GB EIDE	2GB Fast SCSI-2	2.1GB Fast/Wide SCSI-2	2.1GB EIDE
Number Nine Imagine 128 Series II	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Number Nine Imagine 128 Series II
4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB MDRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM
Infotek SRC1702L (17, 15.5)	Hyundai Deluxe Scan 17 (17, 15.8)	ViewSonic Optique V775 (17, 16)	NEC MultiSync M700 (17, 15)	Sampo 17mx (17, 16)	MAG InnoVision DX1795 (17, 16.3)	MAG InnoVision DX17T (17, 16)	Samsung SyncMaster 17GLsi (17, 15.8)	MAG InnoVision DX1795 (17, 16)
Acer 610A-003 (10X ATAPI)	Samsung SCR- 830 (8X ATAPI)	Acer 685A-042 (8X ATAPI)	NEC CDR-1400A (8X ATAPI)	Toshiba XM-5602B (8X ATAPI)	Pinnacle Micro Stringray 8522 IDE (10X ATAPI)	Toshiba XM-3701B (6.7X SCSI-2)	TEAC CD-56E (6X ATAPI)	Acer CD-787E (8X ATAPI)
28.8/14.4	N/A	33.6/14.4	N/A	N/A	33.6/14.4	N/A	N/A	33.6/14.4
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3Com EtherLink III PCI 3C580
Intel Intel 82440FX ■ ■ ■	BCM Intel 82440FX ■ ■ ■	Intel Intel 82450KX ■ ■ ■	Intel Intel 82440FX ■ ■ ■	SuperMicro Intel 82440FX ■ ■ ■	Intel Intel 82440FX ■ ■ ■	Intel Intel 82440FX ■ ■ ■	Intel Intel 82440FX ■ ■ ■	Intel Intel 82440FX ■ ■ ■
128MB	128MB	128MB	256MB	768MB	512MB	128MB	256MB	256MB
3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA
3, 1	4, 1	3, 2	3, 1	3, 2	3, 2	4, 1	3, 1	3, 2
0, 2	0, 4	0, 1	0, 2	0, 2	1, 1	0, 3	0, 1	0, 1
1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1
■	■	■	■	■	■	■	■	■
3 years/3 years N/A	2 years/2 years Included (2 years)	3 years/3 years Included	3 years/3 years Included	3 years/3 years Included	3 years/1 year Included	3 years/1 year Included	3 years/5 years Included	3 years/1 year Included

the future, because expansion options are limited—one PCI/ISA and one ISA slot are still free.

Inside the case you'll see round cables instead of ribbon cables for the 8X CD-ROM and floppy disk drives, a configuration chosen for neatness. Adding another floppy or IDE drive ruins the strategy, however: The round cables have one connector each, so you'll need conventional ribbons in order to add drives.

The Performance Pro 200 lived up to its name on our tests: It tied for first place with two other systems on our High-End Winstone 97 test, and it earned above-average scores on our High-End Graphics and Disk WinMark 97 tests, as well as on our CD-ROM WinMark test. The unit's other test scores were average.

Consider the Sys Performance Pro 200 if you need performance and simplicity more than expansion capability.—**WLR**
Sys Performance Pro 200. Direct price: \$3,699. Sys Technology Inc., Cypress, CA; 800-613-9963, 714-821-3900; fax, 714-821-9592; www.systechtechnology.com. *Circle 476 on reader service card.*

Tagram System Corp. Thunderbolt Pro Media

Believe the adage that "little things will take care of themselves if you solve the big problems" and you'll be in the market for the \$3,445 Thunderbolt Pro Media from direct vendor Tagram System Corp. The expansion potential and peripherals of the unit leave little room for improvement—it's the details that need work.

The Thunderbolt's Tyan motherboard gives you excellent expandability, hosting an extra Type 8 socket for an upgrade to a second CPU. The motherboard provides four PCI slots, though only one is available in the unit: Two are filled (one with a 4MB CMD caching SCSI controller, the other with a Matrox MGA Millennium card) and another lacks a space for its retaining bracket.

The left side of the case slides off for internal access. Remove it, and the case loses its integrity and is readily deformed. The typical cable clutter inside includes two SCSI cables, an 8-bit cable to the 8X CD-ROM drive, and a Fast/Wide SCSI-2 cable leading to the 4.3GB hard disk. The front power button does nothing; the real power switch resides on the rear, in the 235-watt power supply.

Performance was mostly average with two exceptions: The

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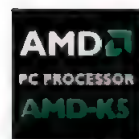
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SUMMARY OF FEATURES

Ends

Pentium Pro PCs

■ YES ■ NO

In alphabetical order by company

	SAG STA Dual P6	Sys Performance Pro 200	Tagram Thunderbolt Pro Media	Tangent Hurricane Pentium Pro	Unisys Aquantia DM/6	Unitak UT- P200N Shadow	Xi Pro200 MTower SP	Zenon Optima Pro Server
Price of tested configuration	\$3,800 (direct)	\$3,699 (direct)	\$3,445 (direct)	\$3,195 (direct)	\$3,990 (street)	\$2,799 (direct)	\$3,749 (direct)	\$3,379 (direct)
Installed RAM and type	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB
Hard disk	Seagate Barracuda ST34371W	Seagate Barracuda ST32550W	Quantum Atlas XP34300W	Seagate Medalist ST32140A	Seagate Hawk ST32155W	Western Digital Caviar AC31600	IBM DFRS-0686S2W	Seagate Barracuda ST32550W
Capacity and interface	4.1GB Ultra SCSI	2GB Fast/Wide SCSI	4.3GB Fast/Wide SCSI-2	2GB Fast ATA-2	2GB Ultra SCSI	1.5GB EIDE	2GB Wide SCSI	2GB Fast/Wide SCSI-2
Graphics adapter	Number Nine Imagine 128 Series II	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Number Nine Imagine 128 Series II	Matrox MGA Millennium	Matrox MGA Millennium	ATI 3D Xpression Pro Turbo PC2TV
Memory	4MB VRAM	4MB WRAM	4MB WRAM	4MB WRAM	4MB VRAM	4MB WRAM	4MB WRAM	4MB SGRAM
Monitor (and screen diagonal claimed/measured, in inches)	MAG InnoVision MXP17F (17, 16)	KDS KD-1700V (17, 16)	ViewSonic Optquest (17, 15.3)	CTX 1785GME (17, 16)	Samsung/Unisys EVG-174-CDL (17, 15.8)	ViewSonic 17GA (17, 16.3)	ViewSonic Optquest V776 (17, 16)	MAG InnoVision DX1795 (17, 16.3)
CD-ROM drive (speed and interface)	Sony CDU-311 (8X ATAPI)	TEAC CD-58E (8X ATAPI)	NEC CDR-1410A (8X SCSI-2)	Toshiba XM-5602B (8X ATAPI)	NEC CDR-1410A (8X SCSI-2)	Sanyo CRD-256P (6X ATAPI)	Toshiba XM-5602B (8X ATAPI)	TEAC CD-56S (6X SCSI-2)
Modem speed (data/fax, in Kbps)	N/A	28.8/14.4	N/A	N/A	N/A	N/A	28.8/14.4	28.8/14.4
Network adapter	N/A	3Com 3C595-TX	N/A	N/A	N/A	3Com 3C595-TX	N/A	N/A
Motherboard Components								
Motherboard manufacturer	Intel	Gigabyte	Tyan	Tyan	FIC	Intel	FIC	SuperMicro
Chip set	Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82440FX	Intel 82450LX	Intel 82450LX	Intel 82440FX	Intel 82440FX
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	512MB	512MB	1GB	1GB	256MB	128MB	768MB	1GB
Expansion-bus slots	3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 4 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI
Accessible drive bays (5.25", 3.5")	3, 2	3, 2	3, 2	2, 3	3, 1	3, 2	3, 2	6, 2
Internal drive bays (5.25", 3.5")	0, 1	0, 3	0, 1	0, 2	0, 3	0, 1	0, 2	0, 3
Parallel/serial/mouse ports	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0
Service and Support								
24-hour, 7-day live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	2 years/2 years	2 years/1 year	1 year/1 year	3 years/3 years	3 years/3 years	1 year/1 year	3 years/3 years	1 year/lifetime
On-site service charge (first year)	\$50.00	Included	\$49.00	Included	Included	\$75.00	Included	\$130.00

N/A—Not applicable. The product does not have this feature.

unit produced below-average scores on our High-End Winstone 97 and Graphics WinMark 97 tests.

Overlook the details and you'll find the Thunderbolt has both flash and sufficient power to get the job done.—WLR

Thunderbolt Pro Media. Direct price: \$3,445. Tagram System Corp., Costa Mesa, CA; 800-824-7267, 714-979-8900; fax, 714-979-8970; www.tagram.com. *Circle 477 on reader service card.*

Tangent Computer Inc. Hurricane Pentium Pro

The price of the Hurricane Pentium Pro from Tangent Computer is meant to blow you away: \$3,195 (direct), with nothing slighted save the last gust of disk speed. Despite a price tag that might make you think someone dropped the Pro from the processor (they didn't), you get a wealth of slots, a socket for a second CPU, and even instructions at the hand-holding level—something all direct vendors should include. The package neglects some details, however, and performance was uneven.

Look closely and you'll find some oddities in the Hurricane Pentium Pro, such as two power switches—a button on the front

panel and a rocker switch on the 235-watt power supply in the rear—wired in series, so both must be on for the system to work. The Tyan motherboard makes up for that, though: It features Intel's 440FX chip set and holds up to 1GB of any kind of memory in its eight 72-pin SIMM sockets. It also offers eight expansion slots, of which seven are accessible (one lacks a hole for a retaining bracket).

A Matrox MGA Millennium card drives graphics, and a Creative Labs sound board provides audio. Disk control, a four-channel EIDE interface, is on the motherboard and links to the Toshiba 8X CD-ROM drive and Seagate 2GB Medalist hard disk.

The highlight of the unit's performance was an above-average CD-ROM WinMark 97 score. Processor and graphics scores were average, but both of its Winstone scores and its Disk WinMark 97 score were below.

Though it may not be perfect, it's affordable—and that may be enough.—WLR

Hurricane Pentium Pro. Direct price: \$3,195. Tangent Computer Inc., Burlingame, CA; 888-826-4368, 415-342-9388; fax, 415-342-9380; www.tangent.com. *Circle 478 on reader service card.*

Unisys PC Division **Aquanta DM/6**

Can the oldest commercial computer maker in the world build a good leading-edge PC? The Aquanta DM/6 leads us to answer in the affirmative. Heir to the original UNIVAC, the \$3,990 (street) Aquanta DM/6 offers a competitive bundle of features with good attention to detail, but poor performance may dissuade some.

The DMI-compliant Aquanta DM/6's mini-tower case is sturdy and has retractable feet for stability. The unit is built around an FIC motherboard that uses Intel's 450KX chip set. Two of three PCI slots are filled (with a Number Nine Imagine 128 Series II graphics board and an Adaptec Ultra SCSI adapter). A Sound Blaster 16 card occupies an ISA slot, leaving one ISA slot and a combination PCI/ISA slot.

Other hardware includes a 2GB Seagate hard disk and an NEC 8X CD-ROM drive. The "phantom bass" listed on the included Altec Lansing ACS51 speakers proved as elusive as the name implies.

Performance is where the Aquanta DM/6 falters. It produced below-average results on both our Winstone tests as well as on the Graphics and Disk WinMark 97 tests. Its other benchmark test scores were average.

The Aquanta DM/6 and its heritage will likely endure, although those with lofty performance requirements should look elsewhere.—WLR

Aquanta DM/6. Street price: \$3,990. Unisys PC Division, San Jose, CA; 888-278-2682, 408-434-2848; fax, 408-434-4844; www.pc.unisys.com. Circle 480 on reader service card.

Unitek Technology Inc. **UT-P200N Shadow**

Lose a little disk space and sturdiness and you get one of the most affordable of these high-powered PCs—the \$2,799 UT-P200N Shadow from Unitek Technology. The unit's performance, however, was disappointing.

First the good news. An Intel Endeavor motherboard anchors the unit with three PCI and three ISA slots and one PCI/ISA slot. A Matrox MGA Millennium graphics adapter fills one PCI slot, and a Creative Labs sound board fills an ISA slot. The motherboard provides the ports and EIDE link to the 1.5GB hard disk and 6X CD-ROM drive.

The weakness lies in the steel case itself. Once you loosen two large screws and pry off the left side, the chassis bends under slight pressure. An industrial-strength motherboard calls for a case that can take abuse. On the positive side, Unitek identifies the ports with icons and includes good peripherals such as a Microsoft Natural Keyboard and a ViewSonic monitor.

The unit did not perform well on several of our tests, earning below-average results on the Winstone 97, Disk WinMark 97, and CD-ROM WinMark 97 tests. Its scores on our other tests were average.

If you are hunting for a bargain and can overlook a couple of shortfalls, the UT-P200N Shadow will bring a good deal into the light.—WLR

UT-P200N Shadow. Direct price: \$2,799. Unitek Technology Inc., Ontario, Canada; 800-944-5650, 909-930-5700; fax, 909-930-5710. Circle 485 on reader service card.

Xi Computer Corp. **Pro200 MTower SP**

The Pro200 MTower SP (\$3,749 direct) gives you an extra pair of SIMM sockets (for a total of six), bringing the total possible system memory up to 768MB. Better still for its target market—primarily engineers and designers—Xi includes an extra software package, Vibrant Graphics Soft Engine for AutoCAD, that helps the graphics card accelerate execution of CAD functions (this package can be replaced by Microsoft Office Pro at no extra cost).

The Pro200 MTower SP comes with four of the seven slots in its FIC ATX motherboard already filled. Two of its three PCI slots hold a Matrox MGA Millennium graphics board and an Ultra Wide SCSI adapter; the inclusion of a U.S. Robotics modem and a Sound Blaster 32 card left two ISA slots and one combo slot free. Mass storage includes a 2GB IBM Wide SCSI hard disk and an 8X CD-ROM drive. The motherboard makes upgrades easy with an auto-sensing voltage regulator and memory sensing that accommodates any variety of SIMM you slide in.

These components paid off for the unit, earning above-average scores on our High-End Winstone 97 test—and a tie with two others for first place—as well as on the High-End Disk WinMark 97 and CD-ROM WinMark 97 tests. The unit's other scores were average.

Strong performance and a good mix of components make this system a worthy contender.—WLR

Pro200 MTower SP. Direct price: \$3,749. Xi Computer Corp., San Clemente, CA; 800-432-0486, 714-498-0858; fax, 714-492-6571; www.xicomputer.com. Circle 486 on reader service card.

Zenon Computer Inc. **Optima Pro Server**

Bigger can be better, particularly when you need expansion room. Among the tallest systems here, the Optima Pro Server puts its volume to work as bay space, giving you six 5.25-inch drive bays and four 3.5-inch bays, all but two of the last external. Factor in the affordable price—\$3,379 direct—and you may fill up those bays faster than you might expect.

The price belies all you get: a dual-CPU motherboard, eight SIMM sockets that handle up to 1GB of RAM, and eight expansion slots. In one PCI slot, Zenon slides a CMD SCSI adapter with 16MB of cache (coupled to a 2GB Fast/Wide SCSI-2 hard disk and a 6X CD-ROM drive), and in another you'll find an ATI 3D Xpression Pro Turbo graphics card. Also included was a 28.8/14.4-Kbps modem (a 33.6/14.4-Kbps modem now ships with the unit).

A huge U-shaped steel cover slides off the case for access to both sides of all drive bays, making installation easy. The only annoyances are the 5.25-inch bay blank panels, which easily come askew. The Zenon unit's performance was impressive: It managed first-place scores on both of our Winstone tests (it tied with two other units on the High-End Winstone 97 test). Most of its other test results were average, except for a below average CD-ROM WinMark 97 score.

The Optima Pro Server's top performance at a low price is well worth a second look.—WLR □

Optima Pro Server. Direct price, \$3,379. Zenon Computer Inc., City of Industry, CA; 800-899-6119, 818-935-1828; fax, 818-935-1826; www.primenet.com/~zenon. Circle 481 on reader service card.



We gave PC Magazine an AST Ascentia J.

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All-Out Search

The Web's top search sites may all be free, but your time isn't. Here's our guide to using these powerful tools efficiently.

By Amarendra Singh and David Lidsky

If it weren't for search sites, your chances of finding anything on the Web would be slim. These sites bring millions of hypertext pages, with their images and multimedia elements, into an orderly, navigable, and—above all—searchable structure. Without search sites, we'd be stuck with a few well-worn bookmarks or doomed to wander blindly from one link to another. With them, we can sort through gigabytes of data in seconds and find what we're looking for on Web servers all over the world. Amazingly, these powerful tools are free for any Web user to access.

Not all search sites are created equal, however. If you depend on information from the Web, you'll want to visit the ones that best repay your time and effort. In preparation for this story, we submitted several thousand simple and complex queries, with and without query customization features, to the Web's top ten search sites.

2. The **search engine** consists of the **query engine**, a **database** with its associated indexing schemes, the engine's **crawler** routines, and one or more Web servers

3. The search engine executes your query against its stored database and returns your **results**. Some but not all engines rank the results by relevance.

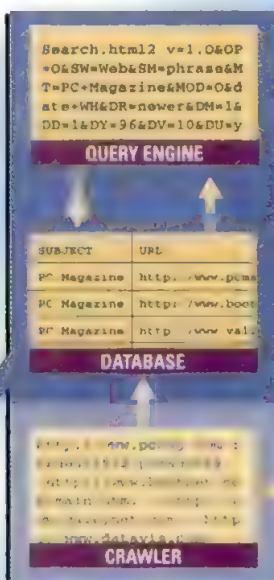
1. **Simple queries** involve entering search terms into a text box. The search engine applies its own heuristics, Boolean operators, or wildcards to find the best answers.

Search [the Web] for [all the words]

PC Magazine

all the words
any of the words
the phrase
the person
the URL

QUERY



Returned 54773 matches

1. PC Magazine: Macintosh, Windows, and...
99%
http://www.pcmag.com/issues/1512/pcmag0089.htm, 312 bytes, 07Jun96

2. PC Magazine: Macintosh, Windows, and...
98% To you, the PC is more than a machine. It's an obsession. For people like you, there's only one magazine that counts.

RESULTS

Search-engine crawlers access Web pages or Usenet news articles, index their contents, then follow the hyperlinks they contain to collect other pages



We drilled down through their directories, read their reviews, sampled their content, and talked to the people who developed them. Not surprisingly, we uncovered some clear winners. But in the process we also discovered that various engines excel at processing different types of queries.

WHAT WE REVIEWED

To be covered in this story, a search site needed to be accessible through the Web, offer a general-purpose index or directory of Web sites, and be freely available for any Web user without special registration. Our initial research turned up 14 sites, which we narrowed to 10 by eliminating those with small-scale databases, very low user traffic, or obviously outdated indexes. The sites we didn't cover were Nexor's Aliweb, Tradewave Corp.'s Galaxy, Tribal Voice's Tribal Search, and New Riders Publishing's WWW Yellow Pages. In addition, MCI Internet Search uses the Open Text search engine, so we did not review it independently. IBM InfoMarket Search is not a true Web crawler but rather collects resource databases, such as BusinessWire. We did not include inquiry.com Inc.'s inquiry.com, as its index focuses on material from computer publications. Finally, we did not include client-side software products, such as Quarterdeck Web Compass, that automate the launching of queries.

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INDEXES AND DIRECTORIES

Today's search sites unite two approaches for managing information on the Web: indexes and directories.

Web indexes are massive, computer-generated databases containing structured information on millions of Web pages or Usenet newsgroup articles. By entering keywords or phrases (and, op-

tionally, special query operators) into the search site's user interface, you can retrieve lists of Web pages that contain your search terms. Web indexes are built by Web crawlers, programs that retrieve HTML pages, scan and index their contents, extract the outbound links they contain, and use those links to retrieve further pages.

Web directories are hyperlinked lists of Web sites, hierarchically organized into topical categories and subcategories. Clicking your way through these lists will lead you to Web site links for the subject you're investigating. Web directories are created by people rather than computers, and they often contain recommendations or reviews of sites. They cover far less ground than Web indexes but are invariably better targeted.

Web indexes represent a purely computational approach to mapping the Web, although the heuristics that the crawlers use can be quite sophisticated. Some crawlers place greater value on keywords that appear in the title, first-level headings, or META tags filled with keywords than on those that appear in the body of the document. The frequency with which a keyword appears is often an important factor, too. Some crawler engines create full-text indexes, while others attempt to extract only significant terms.

Web directories are far more proactive than Web indexes, in that they truly tell

WEB SEARCH SITES

How to Read the Suitability to Task Boxes

Simple searches For uncustomized single-term and multiterm queries, the sites that deliver the highest percentage of relevant hits, with a minimum of dead and duplicate links, receive the highest Power ratings. The Ease rating indicates the clarity of the return set, including site summaries and relevance indicators. The ability to use a hit as a query by example, by asking to see "related sites," improves both the Power and the Ease ratings.

Custom searches Scores for this task rate the tools provided for refining your search. The Power rating rests largely on how well custom queries improve the results over those of simple searches. Sites should support all Boolean operators (AND, OR, and NOT) and a proximity operator (NEAR), and the sites should

SUITABILITY TO TASK		
Product name	Power	
	Power	Ease
Simple searches	Excellent	Excellent
Custom searches	Good	Good
Category searching	Fair	Poor
Web content	N/A	N/A
N/A—Not applicable The site does not offer this feature		

offer a choice between treating keywords as word stems or looking for exact matches. The ability to weight keywords is an important feature. Filtering by domain and date improves the rating, and searching for multimedia files or file types is an added bonus. A graphical interface to help with advanced queries improves the Ease rating.

Category searching For an alternative to keyword searching, sites should offer browsable listings of Web sites organized in categories and subcategories. Sites whose categories consistently lead to relevant information fare well. The Ease score reflects the listings' clarity and logic. Search sites that do not offer a directory structure receive N/A ratings here.

Web content This score is a measure of additional site content. We look for reliable reviews of other Web sites and frequent updates of news and weather. Custom home pages, children's areas, and regional directories are notable extras. The content must be well organized and easily accessible. Sites offering only search options receive N/A ratings here.

you where to go. You benefit from a human presence, in the form of editors who review Web site content and organize the category hierarchy.

Of the sites reviewed here, AltaVista Search, HotBot, Open Text Index, and World Wide Web Worm are classic Web indexes. Four others—Excite, Infoseek, Lycos, and WebCrawler—are hybrids that offer both heavy-duty Web indexes and Web directories. Magellan Internet Guide and Yahoo! are primarily directories, although Magellan also has a searchable database of 15 million uncategorized URLs. Yahoo! has some search capabilities, too, and can pass a query to AltaVista if it can't find what you're seeking on its own.

CUSTOMIZING YOUR QUERY

While you can often obtain high-quality information from Web indexes with simple keyword searching, query customization can improve your returns dramatically, particularly on full-text index sites. All sites in this roundup support some sort of Boolean operators (AND, OR, and NOT), which specify the relations between keywords. AND and NOT can limit a multiterm query, and OR can expand a query. Some sites support parentheses for defining the hierarchy of Boolean evaluation (nested queries), and some let you use quotation marks or other symbols to request the exact matching of a phrase. A NEAR or a comparable proximity operator returns pages containing your keywords if they appear within a specified distance from each other.

Some sites offer filtering options, letting you set a date range for returned pages or limit a query search to a particular domain. As the Web keeps growing, such filter options will become as significant to advanced searching as Boolean operators.

Once your query executes, each of the Web search sites displays the list of hits as

Editors' Choice

- Excite
- HotBot
- Yahoo!



No single Internet search engine will be right for every task.

But our three Editors' Choice winners together will lead you to more Internet content, more of the time, than any other combination we've found.

Excite, the best general-purpose Web search site, delivers a high percentage of relevant hits on simple single- and multiterm queries, without forcing you to perform undue query tweaking. Its ability to sort returns by site provides an invaluable quick overview of a large number of hits. Excite's hits can also serve as queries by example to help you locate similar pages. Excite offers excellent query-refinement tools, including keyword weighting. The site features



more than 60,000 substantive Web site reviews and a bevy of other valuable extras, such as its City.Net regional guides and the Excite Live! personalized news page.

HotBot, the Web's premier crawler, combines a huge database of full-text-indexed pages with a sophisticated user interface. The site's many filter options are easily applied by means of drop-down list boxes or radio buttons, so you can construct complex, customized queries without having to learn an arcane syntax. You can search for phrases, for people, and for URLs, and some of HotBot's inventive filters include searching by domain or Web site. You can also search for file extensions and for most major media types. HotBot delivered highly relevant returns even when we didn't use the site's advanced search options.

Yahoo! is the best Web directory. The site provides you with a solid starting point for finding Web content and invariably delivers links of the highest quality. Yahoo!'s 14 categories and its thousands of subcategories provide the best serendipitous searching available on the Web, and they are an ideal first step in searching for information when you have only the most general idea of what you want. If Yahoo! doesn't have what you want, your keyword query gets sent to AltaVista.

a page containing hyperlinks. The engine may also generate a brief summary of each page or indicate a relevance ranking. Four of the sites—Excite, Infoseek, Open Text Index, and WebCrawler—let you use a hit as a sample to launch a request for similar pages.

Search engine designers are still grappling with problems such as keeping massive indexes up-to-date and determining the quality of the information in a document. But with so many powerful indexes at our disposal, who's complaining? Check out the sites reviewed here; you may be surprised at what you find.

Digital Equipment Corp.

AltaVista Search

When AltaVista Search first launched in December 1995, the site's massive full-text-indexed database and its powerful search tools seemed to provide you with everything you'd ever want in a Web search tool. Today, competitors such as Excite and HotBot claim to have more comprehensive indexes, but AltaVista's advanced searching power continues to hold its own.

AltaVista is best suited to custom searches that make use of its advanced options. The results from simple keyword queries are less impressive. A simple search—AltaVista's default mode—will often return thousands of documents. Its failure to categorize results forces you to sift through these huge return sets manually. Even though AltaVista does not indicate a confidence ranking based on the frequency of your

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A FINISH LINE. TO US
IT'S A STARTING BLOCK.



Introducing cc:Mail R6

Ten million users strong and we still weren't satisfied. In the e-mail category Lotus® cc:Mail® received PC World's 1996 World Class Award and LAN Magazine's Product of the Year among others. But we wanted to make it better. So we did. Introducing Lotus cc:Mail Release 6, featuring: the new 24x7 Post Office which allows users to get their e-mail anytime, any day; enhanced cc:Mail Message Store for increased messaging performance and decreased disk space; plus, integrated Lotus Organizer 2.1^{*} allowing calendaring and scheduling to be quick and efficient for each individual in the group.

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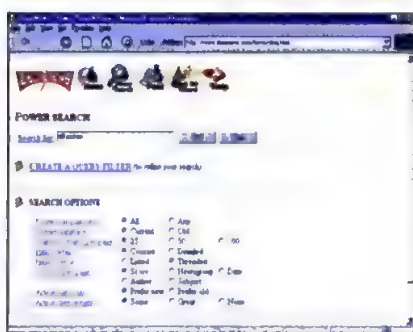
Working Together

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Usenet Searches: Keeping Up with the News

Some 20,000 Usenet newsgroups thrive on the Internet today, accessed by an estimated 24 million people worldwide. A full news feed comes in at about 500MB a day. Finding what you want in this sea of data is definitely a challenge.

We looked at six search engines that let you do just that. Deja News and Reference.COM are solely Usenet search tools, while AltaVista,



Deja News offers the most comprehensive search options of the Usenet search sites.

Excite, HotBot, and InfoSeek are Web search sites that also search newsgroups.

The Usenet search sites archive all postings for the newsgroups they cover. In addition to letting you perform searches, this method lets you view postings that have already been deleted from the actual news servers.

AltaVista (altavista.digital.com) offers powerful query customization but didn't always give us optimal results. One unique feature of the engine is a NEAR operator, which lets you search for words that are ten or fewer words apart. You can also use wildcards in the middle of words. In our test searches, however, AltaVista often listed articles of questionable relevance, while relevant articles found by other search engines were missing from the list.

Deja News (www.dejanews.com) benefits from being designed strictly for use with newsgroups: Its power and bevy of options make it the best site we reviewed. You can view search results

either as a list ordered by criteria you specify or as a thread. You can also search for newsgroups that focus on particular topics, or browse through newsgroups by hierarchy or by geographic region. More than 15,000 active newsgroups are archived. In our test searches, Deja News was very fast, very accurate, and very complete.

Excite (www.excite.com) offered the best Usenet searching we found among those sites not solely dedicated to this task. Searches are fast and accurate. Excite also lets you search only Usenet classified ads, which is convenient if you're looking to buy or sell something. Excite does lack filter options, though, such as being able to view all the articles written by a particular author.

HotBot (www.hotbot.com) offers its wide array of search functionality for searching newsgroups, but its belated entry into the field means that it will have archived only a couple of months of postings by the time you read this. Some of HotBot's advanced search functions prove very valuable for newsgroup searching, especially date filtering and the ability to search for file extensions. But its lack of Usenet-specific features, such as filtering by author, limits you.

InfoSeek (www.infoseek.com) is the weakest Usenet search engine we reviewed. You can't turn off case sensitivity, so a search for *dill pickles* won't turn up articles containing *Dill Pickles*. InfoSeek also lacks filter options—you can't search for all articles by a particular author—and it doesn't support wildcards.

The **Reference.COM** home page (www.reference.com) warns that the product is still in beta testing, but the service offers a wealth of impressive features. You can view messages in an ordered list or as part of a threaded discussion. Over 16,000 active newsgroups are archived, including virtually every hierarchy except *alt.binaries*. A template feature lets you confine a search to a predefined set of newsgroups that all fall within a particular topic area.

Reference.COM is the only search engine we saw that also lets you search for mailing lists, thousands of which are indexed. If you register with Reference.COM, you can also store frequently run queries. You can rerun these manually at a later time, or schedule them to be run automatically on a regular basis (the results are e-mailed to you). This service is free of charge.—*Sheryl Canter*

SUMMARY OF FEATURES

Usenet Search Tools

	AltaVista	Deja News	Excite	HotBot	InfoSeek	Reference.COM
Products listed in alphabetical order	■	■	■	■	■	■
User can see articles in the context of threads	■	■	■	■	■	■
Filters query by date/name/e-mail address	■	■	■	■	■	■
Searches using AND/OR	■	■	■	■	■	■
Searches using NOT/NEAR	■	■	■	■	■	■
Supports nested (parenthetical) searches	■	■	■	■	■	■
Supports wildcards	■	■	■	■	■	■
Supports stemming of words	■	■	■	■	■	■
Organizes return results by newsgroup	■	■	■	■	■	■
Bases return results on keyword frequency	■	■	■	■	■	■
Stores queries	■	■	■	■	■	■
Automatically runs queries	■	■	■	■	■	■



THE BOSS IS GO

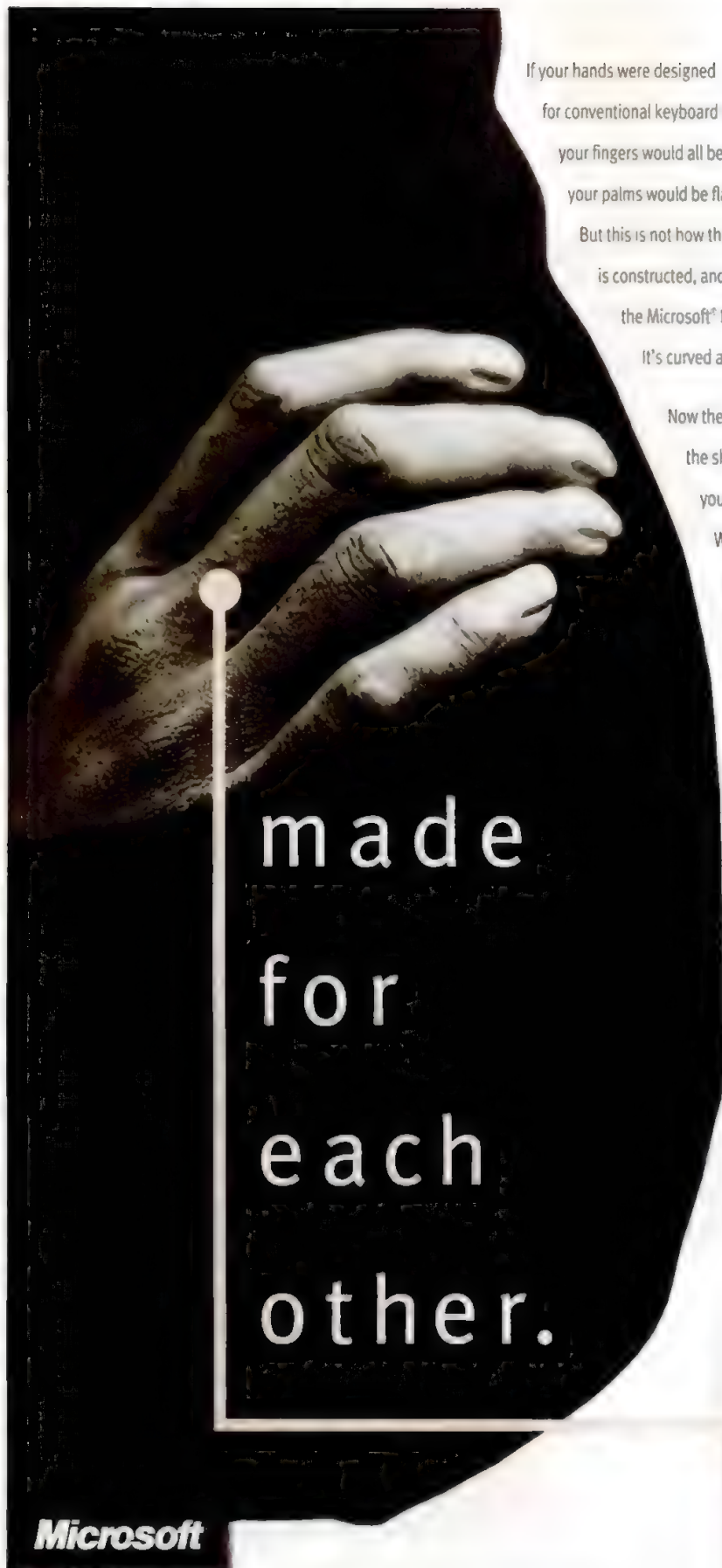


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Because you've got enough to worry about.



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U.S. Robotics
Mobile Communications



If your hands were designed
for conventional keyboard use,
your fingers would all be the same length,
your palms would be flat, and your wrists bent.
But this is not how the human hand
is constructed, and this is not how
the Microsoft® Natural Keyboard® is designed.
It's curved and flexed and contoured like you.

Now the shape of your hands defines
the shape of the keyboard,
you are left working in comfort.

With your hands ergonomically poised,
you compose with greater ease.

You are naturally better able to perform.

Nothing gets between you and your ideas.

You are prepared
to get something accomplished.

Take advantage
of special keystroke timesavers
built-in to simplify your most repetitive tasks.
In other words, glide through your work,
and even more of it without feeling the pinch.

The Microsoft Natural Keyboard,
it will feel different, because it is.
Then it will feel very right, because it is.

Now go and put your hands on one
because it's the feeling of each and every key
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THE Netsearcher's Ultimate CHEAT SHEET

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tricks, and know-how
you need to search*



*the Web, Usenet, White
Pages services, and
MetaSearch sites.*



www.altavista.digital.com

What you can search for: Web and Usenet content.

Basic searching: Searches that use an uncapsitized keyword are always case-insensitive (DAVID = David, DAVID, DaViD, and david), and searches using a word with any capitalization are always case-sensitive. Accent marks are treated the same as capitalization. Exact-word searches are the default. AltaVista parses multiterm queries to find pages with any of the keywords (logical OR).

Customizing your search: You can search for a specific Web page element by identifying the element and then the subject you want (link:pcmag.com or newsgroups:comp.databases). To find plurals, suffixes, and alternate spellings, you can place a wildcard (*) after or in the middle of a keyword. To search for a phrase, you place it in quotes or insert any punctuation mark between the keywords ("boston university" or boston;university). A plus sign in front of a term requires its inclusion in returns; a minus sign prohibits its inclusion. The search tool supports the AND, OR, NEAR, and AND NOT operators, and you can also represent them by the symbols &, |, -, and !, respectively. NEAR returns keywords that are within ten words of each other. AltaVista allows nested Boolean searches by means of parentheses. You can use any of these operators on either the simple-search or the advanced-search page. On the advanced page, you can filter by date and weight keywords via the interface.

Sample custom query: "joe frazier" AND ("cassius clay" OR "muhammad ali") AND Madison;Square;Garden

Tips: You really need to learn the advanced search language to harness AltaVista's considerable power. In particular, use the keyword weighting on the advanced page for more control. When you run the same query on both the simple- and advanced-search pages, you'll get

different results, because AltaVista automatically weights keywords from the simple page.

In short: AltaVista is notable for its full and varied advanced-search syntax, which works extremely well.



www.excite.com

What you can search for: Web content, Excite reviews, Usenet news, and Usenet classifieds.

Basic searching: You can enter natural-language descriptive searches. The search tool treats two words with initial capitalization as a proper name. Multiterm queries turn up pages containing any of the terms (logical OR).

Customizing your search: Excite does not provide a graphical interface for advanced searches. You can enter Boolean AND, OR, and AND NOT operators manually. Unlike with AltaVista, you can enter AND NOT or NOT and Excite will process your query correctly. A plus sign in front of a word forces its inclusion in the returns; a minus sign excludes it from returns. Excite permits nested Boolean searches by means of parentheses. To search for a proper name and another keyword, you put the proper name (with initial capitalization) in quotation marks. To weight one keyword more heavily than others, you follow it with the ^ symbol and a numerical value (Pentium^2 processors).

Sample custom query: (Hugo^3 AND "Notre Dame") NOT Disney

Tips: Use the Sort by Site option, which makes it easy to see how many sites you've found and how many hits each registers.

In short: Excite is a powerful search tool that handles natural-language queries with aplomb, delivers relevant hits, and offers impressive features, such as its keyword weighting.



www.hotbot.com

What you can search for: Web and Usenet content.

Basic searching: You can specify via a drop-down list box to search for "all the words" (AND), "any of the words" (OR), a phrase, a person, or a URL corresponding to the keywords you enter in the text box.

Customizing your search: You click on the Modify button to add more search terms. You can select whether a word, phrase, person, or URL "must," "should," or "must not" appear, via a drop-down list box in the interface. You click on the Expert button to filter your search by date (defined as the date on which HotBot first indexed a page). You can also search by media type (including Acrobat, Java, VRML, or type of file extension); if you select more than one, you'll receive pages that contain all of them. For location searching, you can specify a Cyberplace (a domain or a Web site) or a Geoplace (a geographic region). You can save settings you make in the Expert section as defaults for future visits to the site. HotBot doesn't support wildcards, nor does it automatically stem words.

Sample custom query: Users construct custom queries through a graphical interface.

Tips: Construct advanced queries that include every variable you'd like to see in your returns.

In short: No other search site offers HotBot's sheer range of powerful options. The site is a must for advanced searching.



www.infoseek.com

What you can search for: Web content, Infoseek select sites, Usenet content, company directory listings, e-mail addresses (through

MetaSearch SITES



www.all4one.com

Search engines called: There are 4: AltaVista, Lycos, WebCrawler, and Yahoo!

Structuring your query: You can add complex query syntax, although any engines that don't recognize it will ignore it.

How results are presented: There are four frames, each containing a single search engine's results page.

In short: All4One provides easy searching with dependable results.



www.highway61.com

Search engines called: There are 7, including Excite, HotBot, Infoseek, and Lycos.

Structuring your query: You use simple keyword queries, but you can set AND or OR for a complete multiterm query. You can also specify query intensity and the number of hits displayed.

How results are presented: Results are presented on a single page, with rankings based on how many sites a link was found at and how those sites ranked it. Each returned hit references its sources.

In short: Highway 61 offers reliable returns and useful features for setting a

query time limit. The ability to include Yahoo! categories makes this a valuable tool.



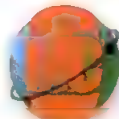
wizard.inso.com

Search engines called: There are 8, including AltaVista, Magellan, Open Text, and WebCrawler, but you can use only one at a time.

Structuring your query: Inso Search Wizard refines your search by proposing several levels of related terms to bolster your initial keyword, and it intelligently processes your selections into the proper structure for whichever engine you choose.

How results are presented: Your query is sent off to the engine you select and displayed there.

In short: Not a pure metasearch site, Inso aids those who aren't familiar with how to construct advanced search queries.



www.metacrawler.com

Search engines called: There are 9, including Excite, Lycos, Open Text, and WebCrawler.

Structuring your query: You have a full range of options through the interface for AND, OR, and NEAR operators, filter criteria for region and domain, and the ability to set the required precision of the match.

How results are returned: MetaCrawler ranks returns by confidence level and indicates the site where each was found. A new Java interface lets you preview your results before the search is finished and verify links.

In short: This is the most accomplished of the metasearch sites we reviewed. Use it.



www.designlab.ukans.edu/ProFusion.html

Search engines called: There are 6, including AltaVista, Excite, Lycos, and Open Text. You can choose any you like, or have the site pick the best 3 for you based on its past history with your query.

Structuring your query: You build simple single or multiterm keyword queries only.

How results are returned: Relevance rankings are recalculated, and you can check for up to 50 broken links, so all returned results are valid. You can request full summaries of the returns.

In short: This is a straightforward site that performs reliably.



guaraldi.cs.colostate.edu:2000/form

Search engines called: There are 28, divided into 8 categories: Web indexes and directories, Usenet, people finders, software, reference, entertain-

ment, and technical reports. You can choose every category, but not every site will be called—only those few that have produced good results with similar queries.

Structuring your query: You can set AND or OR operators for all keywords entered, or have the keywords handled as a phrase.

How results are returned: Results are either separated by their source or integrated. You can set the number of returns from each site, from 10 to 50, and how much summary information is included.

In short: The unique selection of various resources can prove valuable in directing your search, but trying to search everything greatly delays the process.



w3.superseek.com/superseek

Search engines called: There are 10, grouped into 3 categories: Web search engines, Usenet, and Information Super Library FAQ and Bookstore. You can call only to one category at a time.

Structuring your query: You can use keyword searching only, although Infoseek's symbols will be recognized when SuperSeek sends it your query.

How results are returned: A frames-based interface shows each category's returns in individual frames.

In short: Because of some its more specialized resources, it's better for research purposes than for general Web searching.

White Pages SERVICES



An e-mail-address finder, Bigfoot features a simple interface, security features, and an aliasing feature that lets you keep a stable e-mail address regardless of your service provider.



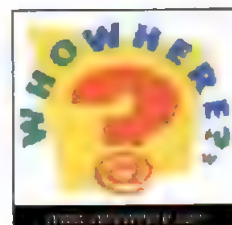
With e-mail and telephone-number searching, and useful filter options like specifying the name of a high school or college, Four11 is the most comprehensive and impressive people finder on the Net.



This telephone-number and mailing-address finder boasts volume, but with only city and state filter options, you might be sifting through a bunch of returns.



Although IAF is especially strong at finding university e-mail address, as well as the addresses of AOL and CompuServe subscribers, it does lack some of the more advanced search-filter options of its competitors.

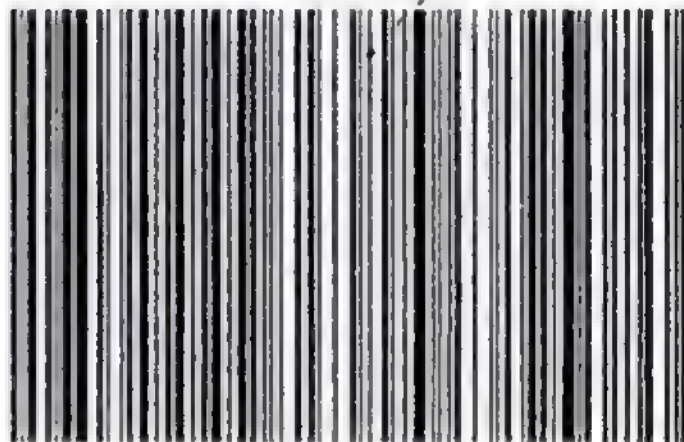


Featuring an impressive collection of personal home pages and security features, this e-mail-address, telephone-number, and mailing-address finder is hampered by a lack of flexible filter tools.

1. Follow instructions on the other side

Back

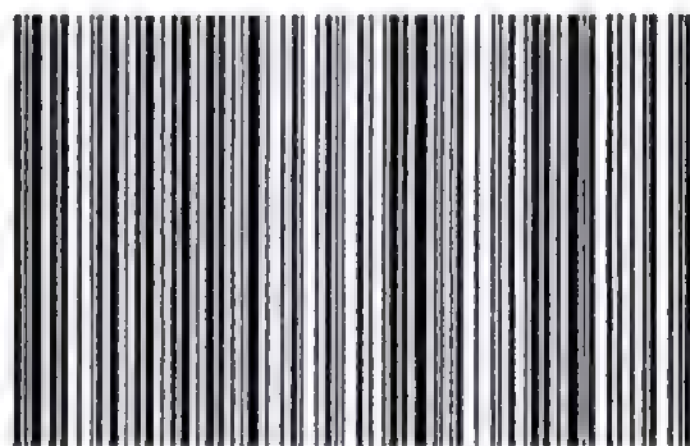
Gbs5lipBack-001B



Inverted Back

1. Follow instructions on the other side

Folded edge of the page



GBS Slip Sheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
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4. Close the page and slip-sheet



Newsgroup SEARCHING



You get the full range of AltaVista search options, but you can't see postings in the context of a thread. The results are not always comprehensive.



Featuring more than 20,000 newsgroups and a variety of search options, Deja News offers accurate and thorough returns and proves the best total Usenet search solution on the Web.



Though you don't have any search options geared toward newsgroups, you receive high-quality returns and can search Usenet classifieds exclusively.



Strong news searching is one of HotBot's many strengths. You can view individual articles and link to related articles in the thread. Clicking on the Usenet newsgroup link launches your news reader.



Infoseek does offer a method of scrolling through a threaded discussion, even if you cannot view the thread all at one time. It lacks newsgroup-specific filter options.



More than 18,000 archived newsgroups, mailing-list searching, and the ability to save frequently run queries make Reference.COM a very solid choice for Usenet searching.

Web Search SITES

Summary of Features

■ YES ■ NO

Serv. as listed in alphabetical order

	AltaVista Search	Excite	HotBot	Infoseek	Lycos	Magellan	Open Text Index	Web-Crawler	World Wide Web Worm	Yahoo!
Web address	www.altavista.digital.com	www.excite.com	www.hotbot.com	www.infoseek.com	www.lycos.com	www.mckinley.com	index.opentext.net	www.webcrawler.com	www.cs.colorado.edu/www	www.yahoo.com
Claimed number of URLs indexed	30 million	50 million	54 million	1.5 million	66 million	6 million	20 million	2 million	3 million	370 000
Accepts URLs from users	■	■	■	■	■	■	■	■	■	■
Complex Searches										
Search using AND/OR/NOT/NEAR	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
User-controlled wildcard	■	■	■	■	■	■	■	■	■	■
Engine supports truncated keywords	■	■	■	■	■	■	■	■	■	■
Supports nested (parenthetical) searches	■	■	■	■	■	■	■	■	■	■
Supports keyword weighting	■	■	■	■	■	■	■	■	■	■
Field-level search by title/head/URL	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Specify Web/Usenet	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Narrow search by domain	■	■	■	■	■	■	■	■	■	■
Narrow search by date	■	■	■	■	■	■	■	■	■	■
Narrow search by database categories	■	■	■	■	■	■	■	■	■	■
Query by example	■	■	■	■	■	■	■	■	■	■
Display										
Set maximum number of hits returned	■	■	■	■	■	■	■	■	■	■
Set number of hits displayed	■	■	■	■	■	■	■	■	■	■
Engine eliminates duplicate hits	■	■	■	■	■	■	■	■	■	■
Content										
News/weather headlines	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Sports/entertainment headlines	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Business news/Stock quotes	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Regional services	■	■	■	■	■	■	■	■	■	■
Web site reviews	■	■	■	■	■	■	■	■	■	■
Listings of recommended sites	■	■	■	■	■	■	■	■	■	■
Child-oriented site	■	■	■	■	■	■	■	■	■	■
Customizable start page	■	■	■	■	■	■	■	■	■	■

WhoWhere?), timely news, and Web FAQs.

Basic searching: By default, multiterm queries return only pages that contain all the keywords (logical AND). The search tool requires you to capitalize proper names, and it considers any two adjacent capitalized words a proper name. You can enter natural-language terms in lieu of constructing keyword queries.

Customizing your search: You use a plus sign before words that must appear in the results and a minus sign before words that must not appear (chips -tortilla). To ensure that the words in a phrase appear together in the results, you can put quotation marks around the phrase or place hyphens between each pair of words ("class clown" or class-clown). Keywords you place between brackets ([wheelchair access]) will appear in the results within 100 words of each other. When searching for several proper names, you separate them with commas (Michael Miller, PC Magazine).

Sample custom query: "green eggs and ham" Dr. Seuss

Tips: Click on the Similar Pages link after a relevant hit to modify your query; this approach is often more effective than constructing a complex query.

In short: Infoseek's myriad databases give you flexibility in narrowing your search from the start. Also check out Ultra for domain and multimedia searching.



www.lycos.com

What you can search for: General Web content, sounds, pictures, or subjects through Lycos's A2Z catalog.

Basic searching: Multiterm queries return results containing any of your keywords (logical OR). Lycos looks for a loose match of a keyword by default, and it automatically performs wildcard searching on keywords.

Customizing your search: The customizable search interface lets you opt to receive pages that contain all your keywords (logical AND) or two to seven of them. You can also match your keywords with varying degrees of precision: loose, fair, good, close, or strong. A period after a word will elicit an exact match; a dollar sign can be used as a wildcard (basket\$ returns basketful, basketball, and so on). A minus sign before a keyword will exclude it from the results (needles -knitting).

Sample custom query: dream. interpret\$

Tips: Beware of using numbers or symbols in your queries, because Lycos doesn't handle them well. Use Lycos to find multimedia clips and still images, but for general queries, if you don't find what you are looking for on your first attempt, try another engine.

In short: Lycos gives you many services to find what you want on the Web, including its A2Z category searching and Point's top 5 percent of the Web.



www.mckinley.com

What you can search for: Web pages, sites that Magellan has rated and reviewed, or sites that Magellan has approved as not containing adult content ("green light" sites).

Basic searching: Keyword searches return all sites that contain any of your keywords (logical OR).

Customizing your search: For multiterm queries, you can have the results include all of your keywords (logical AND). You can type in Boolean operators as well: Magellan supports AND (or a plus sign before a word) to require a keyword's inclusion in results, OR to expand your query, and AND NOT (or a minus sign before a keyword) to exclude a term from the results. You can also create nested Boolean searches using parentheses. You can filter by rating, choosing to see only sites rated with three or more stars or only those rated with four stars. You can set the interface options as defaults for an entire searching session or for only one search.

Sample custom query: lasagna AND (spinach OR mushroom) -gravy

Tips: Magellan's 26 categories and multiple subcategories offer a great way to find highly rated Web sites.

In short: A site that centers on reviews written by an editorial staff, Magellan ensures that the assessed sites will turn up information worth your time.



index.opentext.net

What you can search for: Web content, newsgroups (through Deja News), and e-mail (through Four11).

Basic searching: You can opt to search for either words or a phrase. Multiterm queries return pages containing all of your keywords (logical AND). The search tool ignores case and some punctuation.

Customizing your search: You click on the PowerSearch link to go to the advanced-search interface, which you can use to select page elements in which you want to find certain keywords: anywhere on the page, within Open Text's summary of the page, in the title, in the first heading, or in the page's URL. You can link keywords with Boolean and proximity operators. You can select AND, OR, BUT NOT, NEAR, and FOLLOWED BY from the drop-down list box on the interface. The NEAR operator links words appearing within 80 words of each other on a page.

Sample custom query: Users construct custom queries through a graphical interface.

Tips: Open Text does not stem words, so you should link singular and plural versions of a word with the OR operator, using the interface.

In short: Despite the sophisticated interface for query building, simple keyword or phrase searching works best.



www.webcrawler.com

What you can search for: Web content.

Basic searching: Multiterm queries return pages that contain any of your keywords (logical OR).

Customizing your search: There is no GUI for advanced searches. You can perform Boolean searches using AND, OR, and NOT operators, nested Boolean searches using parentheses, and proximity searches using the NEAR and ADJ operators. If you specify a number after the NEAR operator (disability NEAR/10 insurance), your keywords must

appear within ten words of each other on a page. Using the ADJ operator will require the keywords to appear next to each other in the order entered. You can also put a phrase in quotation marks if you want it to appear exactly in your returns.

Sample custom query: root NEAR/20 vegetable NOT gardening

Tips: If WebCrawler doesn't get it right the first time, custom syntax may not improve matters. Consider trying your query on another engine.

In short: A powerful engine with a good selection of Web site reviews, WebCrawler often delivers the goods.



www.cs.colorado.edu/wwwwww

What you can search for: Web content.

Basic searching: By default, multiterm queries return pages containing all your keywords (logical AND). Also by default, you search for both the hyper-text references to URLs and the URLs themselves.

Customizing your search: For multiterm queries, you can specify through the interface that the returned pages can include any of the terms (logical OR). In lieu of searching for all references to a URL, you can search only for appearances of the URL address. You can also search only in document titles or addresses.

Sample custom query: Users construct custom queries through a graphical interface.

Tips: The default number of page returns is 5; increase it to 500 to get better results.

In short: A little different from the rest of the pack, WWWorm is of limited utility but may occasionally surprise you.



www.yahoo.com

What you can search for: Web content via a directory of prescreened sites, Usenet content (through Deja News), and e-mail (via Four11).

Basic searching: When you enter multiple keywords, Yahoo! returns pages containing all the terms (logical AND). It automatically puts a wildcard after every term (Albert = Albert, Alberta, and so on). By default, Yahoo! searches its entire database, regardless of the document's date.

Customizing your search: Yahoo! doesn't let you enter Boolean or other symbols into the query window. To customize your search, click the Options button and use the form provided to narrow your search to the Web, Usenet, or e-mail addresses; to set a date range; to indicate logical AND or OR; to search for substrings or complete words; and to set the number of returns per page. You can also filter by the date Yahoo! indexed the page.

Sample custom query: Users construct custom queries through a graphical interface.

Tips: If you aren't looking for something specific, try using Yahoo!'s categories to drill down and narrow your search.

In short: An excellent starting point for Web searching, Yahoo!'s well-organized Web catalog either delivers high-quality hits or sends you to AltaVista to get what you want.

Dear **new**
computer company,

you **WON** our
business because:

1. your technology is
leading edge.
2. your customer service is
**outrageously
responsive.**
3. your price:performance
is **truly
competitive.**

i'm glad i called you.

Zenith Data Systems Direct...

it's the way to do business

now.

Introducing the new Zenith Data Systems Direct.
The way to do business now.

For intelligent computing customers, it's all coming together in one company. • Leading Edge Technology and a company-wide commitment to quality geared to meet your most demanding desktop, notebook and server applications. • High Speed Hardware that protects your investment • Knowledgeable and Friendly Consultants to minimize downtime • And a determination to deliver maximum Computing Value.

That's Zenith Data Systems Direct...the way to do business now.



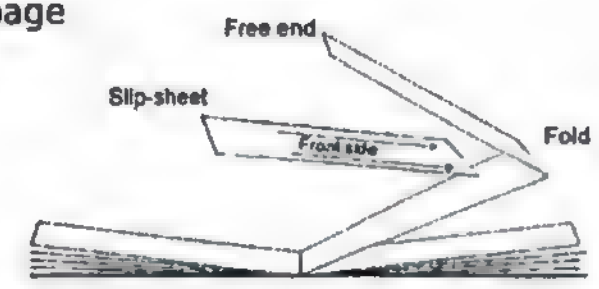
ZENITH DATA SYSTEMS

D · I · R · E · C · T

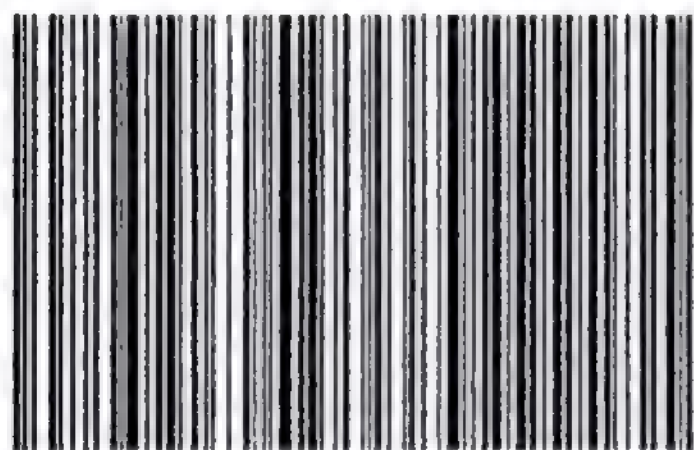
Turn the page for even more outstanding
high performance values...

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

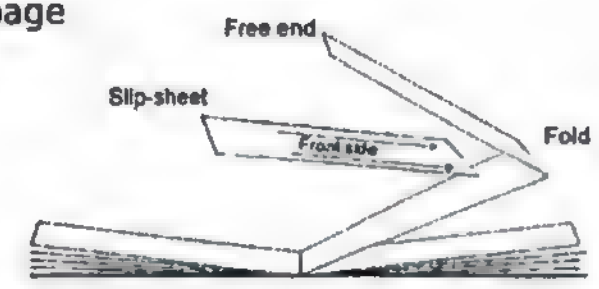


GbsSlipSheet-001

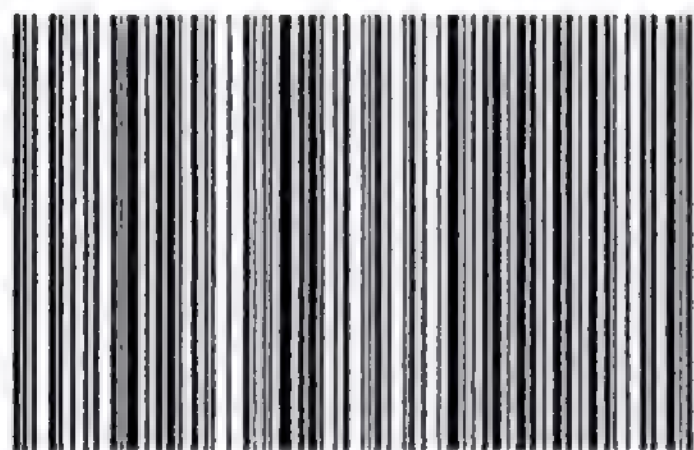
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Foldout slip-sheet

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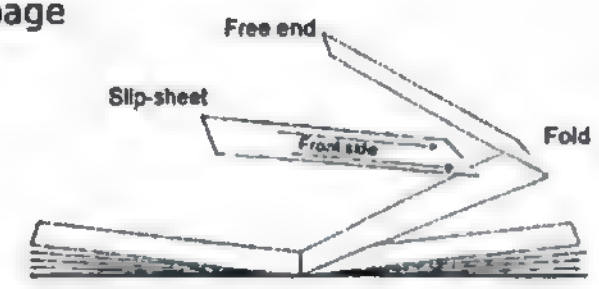


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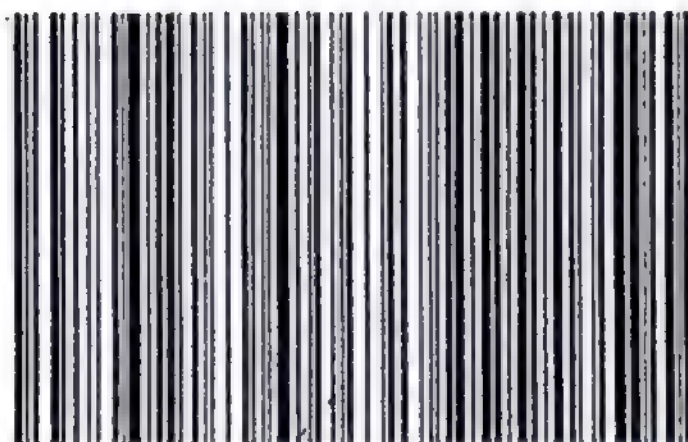
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1. Follow instructions on the other side

Inverted Back



GbsSlpBack-001B

Back

1. Follow instructions on the other side

professional

performance 166

- 166MHz Intel Pentium® Processor
- 16MB EDO Memory, Expand to 128MB
- 256K Pipelined Burst Cache
- 2.1GB EIDE Mode 4 Hard Drive
- 128-bit Video with 2.25MB MDRAM
- 8X EIDE CD-ROM Drive
- 15" (13.7" Viewable) .28 Pitch Monitor
- Microsoft® Windows® 95
- Microsoft® Office Professional
- 3 Year Limited Warranty

Same system with 133MHz Intel Pentium® Processor for \$1759

\$1969

F162E

Business Lease for \$67/mo

performance 200m

- 200MHz Intel Pentium® Processor
- 64MB EDO Memory, Expand to 128MB
- 256K Pipelined Burst Cache
- 3.1GB EIDE Mode 4 Hard Drive
- 128-bit Video with 2.25MB MDRAM
- 12X EIDE CD-ROM Drive
- 17" (15.5" Viewable) .28 Pitch Monitor
- 28.8kps FAX Modem
- Creative Labs AWE32 Wavetable Soundcard
- Altec Lansing® Stereo Speakers
- Microsoft® Windows® 95 or NT 3.51
- Microsoft® Office Professional
- 3 Year Limited Warranty

\$2999

F208GMM

Business Lease for \$103/mo



notebooks

z-star mx 120

- 120MHz Intel Pentium® Processor
- 10.4" Active-Matrix with 800x600 Color Display
- 16MB DRAM, Expandable to 40MB
- 1GB Hard Drive
- NiMH battery
- Infrared IrDA Port
- 256 Synchronous Pipelined Burst Cache
- 16-bit sound
- Built-in Microphone and Stereo Speakers
- TrackPad Ergonomic Pointing Device
- Microsoft® Windows® 95
- One Year Factory Parts and Labor Warranty
- 5.9 lbs.

\$2599

SNP1206A

Business Lease for \$89/mo



z-star gx 133

- 133MHz Intel Pentium® Processor
- 12.1" Active-Matrix with 800x600 Color Display
- 16MB DRAM, Expandable up to 40MB
- 1.3GB Hard Drive
- 6X CD-ROM Module
- Lithium Ion Smart Battery
- Infrared IrDA Port
- 256K Synchronous Pipelined Burst Cache
- 128-bit graphics accelerator with 1MB Memory
- 16-bit sound
- Built-in Microphone and Stereo Speakers
- TrackPad Ergonomic Pointing Device
- Microsoft® Windows® 95
- One Year Factory Parts and Labor Warranty
- 6.1 lbs.

\$3449

SNC0363A

Business Lease for \$118/mo

multimedia

check out our complete software bundle listing on the following page

z-station vx 133

- 133MHz Intel Pentium® Processor
- 16MB EDO Memory, Expand to 128MB
- 256K Pipelined Burst Cache
- 2.1GB EIDE Mode 4 Hard Drive
- 64-bit 3D Video with 2MB EDO Memory
- 8X EIDE CD-ROM Drive
- 33.6 Kbps FAX Modem
- Telephone Answering Device & Speakerphone
- 16-bit SRS 3D Wavetable Audio
- Altec Lansing Stereo Speakers
- 15" (13.7" Viewable) .28 Pitch Monitor
- Microsoft® Windows® 95
- Corel WordPerfect Suite 7
- Z-MPC bundle
- 3 Year Limited Warranty

\$1759

M132E

Business Lease for \$60/mo

z-station vx 166

- 166MHz Intel Pentium® Processor
- 32MB EDO Memory, Expand to 128MB
- 256K Pipelined Burst Cache
- 2.5GB EIDE Mode 4 Hard Drive
- 64-bit 3D Video with 2MB EDO Memory
- 8X EIDE CD-ROM Drive
- 33.6 Kbps FAX Modem
- Telephone Answering Device & Speakerphone
- 16-bit SRS 3D Wavetable Audio
- Altec Lansing Stereo Speakers
- 17" (15.5" Viewable) .28 Pitch Monitor
- Microsoft® Windows® 95
- Corel WordPerfect Suite 7
- Z-MPC bundle
- 3 Year Limited Warranty

\$2329

M165F

Business Lease for \$80/mo

z-station vx 200

- 200MHz Intel Pentium® Processor
- 32MB EDO Memory, Expand to 128MB
- 256K Pipelined Burst Cache
- 3.1GB EIDE Mode 4 Hard Drive
- 64-bit 3D Video with 2MB EDO Memory
- 8X EIDE CD-ROM Drive
- Iomega Zip 100
- 33.6 Kbps FAX Modem
- Telephone Answering Device & Speakerphone
- 16-bit SRS 3D Wavetable Audio
- Cambridge Soundworks Speakers w/Subwoofer
- 17" (15.5" Viewable) .28 Pitch Monitor
- Microsoft® Windows® 95
- Corel WordPerfect Suite 7
- Z-MPC bundle
- 3 Year Limited Warranty

\$2629

M205G

Business Lease for \$90/mo

professional pro

special!

performance pro 200

- 200MHz Intel Pentium® Pro Processor
- 32MB EDO Memory or FPM Memory, Expand to 128MB
- 256K Pipelined Burst Cache
- 3.1GB EIDE Mode 4 Hard Drive
- 128-bit Video with 2MB MDRAM
- 12X EIDE CD-ROM Drive
- 17" (15.5" Viewable) .28 Pitch Monitor
- Microsoft® Windows® NT
- Microsoft® Office Professional
- Supports remote management through DMI
- 3 Year Limited Warranty

\$2599

R205G

Business Lease for \$89/mo

performance pro 200p

- 200MHz Intel Pentium® Pro Processor
- 64MB EDO Memory or FPM Memory, Expand to 128MB
- 256K Pipelined Burst Cache
- 4GB SCSI Hard Drive
- 128-bit Video with 2MB MDRAM
- 12X SCSI CD-ROM Drive
- 17" (15.5" Viewable) .28 Pitch Monitor
- Microsoft® Windows® NT
- Microsoft® Office Professional
- Supports remote management through DMI
- 3 Year Limited Warranty

\$3699

R208J

Business Lease for \$126/m

performance 200c

- 200MHz Intel Pentium® Processor
- 16MB EDO Memory or FPM Memory, Expand to 128MB
- 256K Pipelined Burst Cache
- 2.1GB EIDE Mode 4 Hard Drive
- 64-bit Video with 2MB EDO
- 8X EIDECD-ROM Drive
- 15" (13.7" Viewable) .28 Pitch Monitor
- Microsoft® Windows® 95 or NT
- 3 Year Limited Warranty

\$191

F2

Business Lease
for \$66/mo

servers



Call for our full line of server products featuring the power and endurance you need to move your data. Our dedicated technical support team is ready to custom configure a cost-effective system that meets your information strategy.

Call us, we're ready to help.

z-mpc software bundle

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warranty information

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Using AltaVista's Advanced Search page dramatically improves your results.

keywords, we discovered that the quality of the responses dropped off dramatically after the first couple of pages of results. AltaVista does not provide categories, lists of hot sites, news, or any of the content offerings you can find on many competing sites.

You must learn the advanced query methodology in order for AltaVista to be a valuable tool. AltaVista's Advanced search page provides you with the full range of search options, but you can use all the operators on the simple search page, too. You can specify Boolean operators (AND, OR, and NOT), specify the maximum distance between keywords, perform case-sensitive searches, and filter out Web pages by setting a specific date range. You can add wildcards, both at the end of a keyword to catch any plurals or suffixes, and within a word to catch alternative spellings. You can also restrict your search to specific elements, such as links.

One of the most valuable features on the Advanced search page is called "results ranking criteria." This feature allows you to weight keywords in order to push the most relevant documents to the top of the returns. After we began with a general query, we found it to be a great tool for refining our search.

If you're looking for highly specific information and are willing to learn the intricacies of advanced search syntax, Al-

taVista is still a powerhouse. But for simple keyword searching, it's a weaker choice because of its inelegance in returning the results.—*Amarendra Singh*

AltaVista Search. Digital Equipment Corp., Maynard, MA; 800-344-4825; www.altavista.digital.com.

Excite Inc.

Excite



A powerful search engine plus personalized, self-modifying information delivery and a slew of Web site reviews from a competent editorial staff add up to a Web search tool that's more than worth your time.

Excite's search engine uses a combination of standard keyword searching and content-based heuristics that usually turned up relevant Web pages, even when those Web pages didn't contain the exact search words we specified. Excite claims its database contains more than 50 million full-text-indexed pages.

In our tests, Excite's engine worked well, consistently returning relevant URLs even for long search strings. Excite also does a tolerable job of eliminating duplicate URLs, although it's one of the worst offenders with respect to delivering multiple pages from the same site in your top ten hits.

Search results are shown with the page title, full URL, a brief summary, and a confidence ranking. A "More Like This" option for each hit provides an effective query-by-example for zeroing in on similar pages. A "Sort by Site" option groups the hits by domain, with all pages in a domain indented under the site heading, making it easy to see how many sites you've turned up and how many relevant pages you've found on each one.

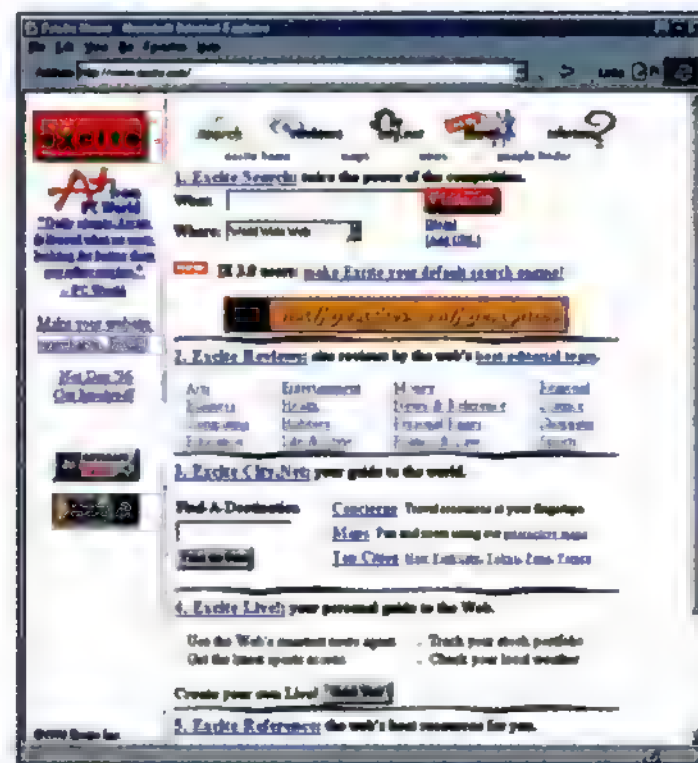
Excite lets you restrict your search to the Web, Usenet news, Usenet classifieds, or Excite reviews. For advanced searching, it offers standard Boolean options, including nested Boolean searches. You can also increase the importance of a particular search term by appending a caret (^) and specifying a weighting value. Excite assumes you are searching on a proper name when you capitalize the first word in a two-word search. There is no special

query-builder interface to help you construct complex queries, but help is easily accessible and the operators are standard.

Excite offers a wealth of content on its site. You'll find reviews of more than 60,000 Web sites categorized under hierarchical subject headings. Each review is about four lines long, and together they do a reasonable job of summarizing the surprisingly full selection of covered sites.

City.Net, an Excite feature that's rich enough to be a standalone site, provides regional guides and relevant links for thousands of worldwide destinations. An Interactive Maps option helps you find your bearings, and the Concierge can link you directly to sites where you can make dinner reservations or get ticket prices for a concert.

Excite Live!, a new Excite service, provides a Web news magazine you can personalize. Its NewsTracker subset culls in-



Excite may be cluttered, but that shouldn't deter you from harnessing its search power.

formation from about 400 selected Web magazines based on selected starting topics and search words. NewsTracker even proposes related words that might help your search, although in practice a lot of the suggestions were pretty far off the mark. The results have a "Liked It" button, which NewsTracker uses to hone in

SUITABILITY TO TASK

AltaVista Search

	Power	Ease
Simple searches	Fair	Good
Custom searches	Excellent	Fair
Category searching	N/A	N/A
Web content	N/A	N/A

N/A—Not applicable. The site does not offer this feature.

SUITABILITY TO TASK

Excite

	Power	Ease
Simple searches	Excellent	Excellent
Custom searches	Excellent	Good
Category searching	Excellent	Good
Web content	Good	Good



HOW TO SELL YOUR

STEP # 1

What is a Lexmark?

Lex•mark\ (leks•märk) n \

It's a printer, like the
2050 Color Jetprinter™

pictured here. But
if you didn't
know that,
don't sweat
it. Research

The Lexmark 2050
Color Jetprinter.

shows most people
in the market for a

good, affordable printer don't yet
know our name. There's a reason.

Lexmark' has been making
printers for business
applications for

years. (Our
printers print
about 100
million pages a

day for banks, pharmacies and
other big businesses.) And now
we're applying that experience to
small-office and home printers.



Step # 2 OVERCOMING OBSTACLES



"I kinda like
the Epson."



"The Canon' is
pretty good."



"I'd go with HP."



"Lexmark?
Never heard of it."

Talk to most people and you're bound to hear the same few names come up again and again. And we admit they make good products. But frankly, we wouldn't have entered the market if we didn't have something better to sell. (We may be unknown, but we're not stupid.) So how is the Lexmark 2050 better? For starters, it's a lot faster than the Epson 500. We use a patented waterproof black ink that's better than the ink used in the Canon 4200. And it comes with more software packages than the HP 682C. We even throw in a paper pack, so you can print great stuff the minute you get home.

SELF A LEXMARK.

STEP
#3

FINDING A LEXMARK PRINTER.

Look, we'll be honest. You may have to look a little harder to find a Lexmark. You may have to search high and low. But we're not complaining. We know we have to earn our place in the stores. So we do everything we can to make sure that when you do find one of our printers, it's worth the effort.



STEP #4

GETTING THE BEST VALUE. A MESSAGE FROM OUR CHIEF FINANCIAL OFFICER.

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the Internet and World Wide Web. (Some of our competitors only give you limited software.) And we have a 24-hour exchange warranty. Why does Lexmark give you so much for less? Well, the answer is a little embarrassing. It's because you don't know who we are. We have to."



*The Unknown CFO of Lexmark International, Inc.
The Unknown Printer Company.*

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on articles you're more likely to be interested in. A nice selection of maps and people-finding tools rounds out Excite's arsenal of value-added content.

The only real negative is Excite's chaotic interface, a veritable thicket of search tools, content listings, services, and announcements. An optimist would say that it's a token of how much is crammed into this otherwise highly impressive and reliable search tool.—*Michael Muchmore*
Excite. Excite Inc., Mountain View, CA; 415-943-1200; fax, 415-943-1299; www.excite.com.

Hotwired Inc. and Inktomi Corp.

HotBot



With a claimed full-text-indexed database of about 54 million documents, HotBot is one of the most comprehensive search engines on the Web. Its easy-to-use Boolean search features and its ability to search by media type and "Cyberplace" (any domain or Web site) go a long way toward helping you find what you need without requiring you to

wade through what you don't.

HotBot was best at searching for specific words or phrases, such as *Baha'i* or *1995 Coca-Cola Annual Report*. It also did well in searches that were based on detailed queries.

HotBot (developed jointly by Hotwired and Inktomi Corp.) ranks search results according to a number of factors, including a term's frequency in a given document and its appearance in the title and in the keyword META tag. Although this ranking wasn't always the best indicator of relevance, we were almost always

LAB TESTS

Web Search Sites



Our tests turned up huge differences in the number of relevant hits that each engine returned, in the presentation of the return sets, in the operators available for refining queries, and in the filtering tools provided for focusing searches.

How We Tested

To test Web search sites, we devised 50 queries spanning a variety of subjects. In order to evaluate how each engine handled different types of queries, we included both single and multiple search terms, as well as keywords that were acronyms or hyphenated words, or that contained numbers.

We initially submitted each of the queries using the default entry field and without adding any special customization syntax. We then examined each of the first ten hits, evaluating each page's relevancy and recording the number of duplicate links and dead links.

Because "relevancy" can be a matter of opinion, a second person repeated a subset of the queries on each engine in order to check the results. Our ratings reflected both the number of relevant hits and the quality of the information to which they pointed. We also rechecked dead links over a two-week period, in order to ensure that each was a genuine 404 error and not the result of a temporary glitch in the remote host. Although many engines returned pages from mirror sites containing the same content, we did not score these instances as duplicate hits, because they involved two URLs.

To evaluate each site's custom query tools, we attempted to refine the queries by employing the available Boolean, proximity, and weighting operators and by adding keywords where necessary. We also applied relevant filter options, such as domain or the HTML page element we wanted to scan, if the engine supported them.

The goal of this exercise was to see if we could improve the quality of the return set through query customization, but without pursuing this process beyond a reasonable limit. As before, a second tester repeated the process based on a subset of the original sample queries, this time in order to even out individual differences in approach.

The table below summarizes all these test results. We opted for using a four-level scoring system rather than for publishing percentages. Given the "fuzzy" nature of the query process, as well as the varying degree of operator skill that different engines require to produce a good result, a more granular scoring system would not necessarily be a good predictor of how you might fare with a given query.

We did not attempt to evaluate search engine performance. Search engine work loads and cache states, as well as Internet routing and bandwidth, are inherently unreproducible and, for practical purposes, cannot be measured. Any server performance score that we made without reference to these variables would be totally invalid. Real-world users in different locations will experience widely fluctuating performance, as a result of any or all of these factors.

We performed all testing using a variety of 486- and Pentium-based systems running Windows 95, Netscape Navigator 3.0, and Microsoft Internet Explorer 3.0. They were connected to the Internet through a 16-Mbps Token-Ring LAN routed to a T1 line to our Internet service provider.—*Jay Munro and David Lidsky*

Query Tests: How They Fared

★★★★ Excellent ★★★ Good ★★ Fair ★ Poor

	Relevant hits from initial query	Effective query customization	Eliminates duplicate links	Eliminates dead links
AltaVista	★★	★★★★	★★★	★
Excite	★★★★	★★★★	★★★	★★★
HotBot	★★★	★★★★	★★★	★★★
Infoseek	★★	★	★★	★★★★
Lycos	★★	★★	★★★★	★★★
Magellan	★	★★★	★★	★★★
Open Text	★★★	★★	★★	★★★★
WebCrawler	★★	★★	★★★★	★★
WWWorm	★	★★	★	★★★
Yahool	★★★★	★	★★★★	★★★★

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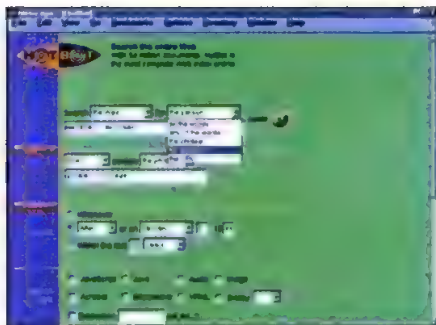
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HotBot's filtering options, including searching for media types, are without peer.

able to find what we were looking for among the top 20 hits.

No other search site offers the range of options that HotBot does in its interface. The opening search screen lets you specify all or some of your search terms, a phrase, a person, or a URL. The person-search feature offers a limited proximity search, so that specifying *Aaron Copland* returns *Copland, Aaron* as well.

Click on Modify to give priority to certain words or exclude others. HotBot's Boolean capabilities are flexible. You'll also want to familiarize yourself with the

Expert search menu. HotBot can limit a search to a specific media type or file extension, such as VRML or .GIF. You can also limit a search to a geographic region, a domain, or even a Web site. All of Hot-

SUITABILITY TO TASK

	HotBot	
	Power	Ease
Simple searches	Good	Excellent
Custom searches	Excellent	Excellent
Category searching	N/A	N/A
Web content	N/A	N/A

N/A—Not applicable: The site does not offer this feature.

White Pages Services: Finding People on the Net

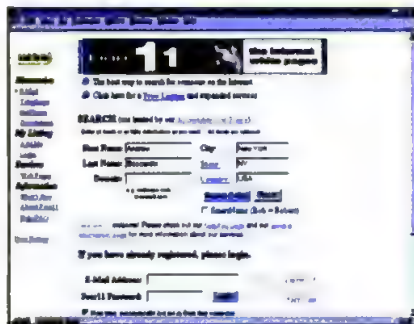
If you've lost touch with an old business colleague or high-school sweetheart, White Pages search sites may be able to reunite you. These search engines can help you locate e-mail addresses or phone numbers; we looked at five free services devoted to helping you find a person or business anywhere in the United States.

These sites compile the bulk of the information in their databases from public sources, such as the online directories used by universities, charities, and some businesses, as well as phone books from across the country. The sites rely heavily on user input, and so contain information that may be out of date or missing. You can also choose to remove yourself from a site's database. No one site is the definitive source for online people finding, so if you can't find someone with one service, try another.

A good starting point is **Bigfoot** (www.bigfoot.com), which uses a simple single-field interface to search its steadily growing database of e-mail addresses. You can place information like your alma maters and employers in your profile, but Bigfoot doesn't yet provide the means to filter or execute a search based on those fields. It does offer a nice security feature that lets visitors send you a greeting without having your e-mail address. Bigfoot is also offering free e-mail for life on its site, letting you maintain one e-mail address regard-

less of your service provider.

The most comprehensive site we reviewed, **Four11** (www.four11.com), permits searching of both e-mail and phone directories, and has some strong advantages over the other sites. The advanced search form provides the most specific filters we saw for narrowing a search, including searching by high school, college, or other organization. You can craft very narrow searches for a person or run broader queries that don't include specific names. The



Find your lost love or old business colleague with Four11's extensive filter options.

user update form lets the user create a more extensive online entry than other sites do, and every field on the update form can be used as a filter on the advanced search form.

Internet Address Finder (www.iaf.net) brought solid returns for general e-mail address searching, especially from universities and the larger service providers like AOL and CompuServe. While the site is devoted primarily to

finding e-mail addresses, it also lets users add additional information, such as their organization and domain names, to a user profile. But you cannot search on these additional fields to find someone belonging to a certain organization as you can with Four11, because you need to enter a last name and at least one character of a person's first name to use these filters.

For sheer volume of search returns, no one can beat **Switchboard** (www.switchboard.com), a telephone and mailing address directory created by Banyan Systems. While the database had been updated four weeks before our testing, many searches still returned outdated results. The only filtering is by city and state, so if you don't already know where your search subject is living, you may be overwhelmed by the number of returns.

WhoWhere? (www.whowhere.com) is very similar in form and function to Four11 but lacks that site's more adaptable search controls. Multiple fields like alma mater and occupation, which are available for updating, are represented in the advanced search by a single field, limiting your search and filtering options. WhoWhere? does feature an impressive index of personal home pages and Yellow Pages directories. Like Bigfoot, WhoWhere? also offers a security option that sends messages to search subjects rather than releasing their e-mail addresses.—*Andrew Boscardin*

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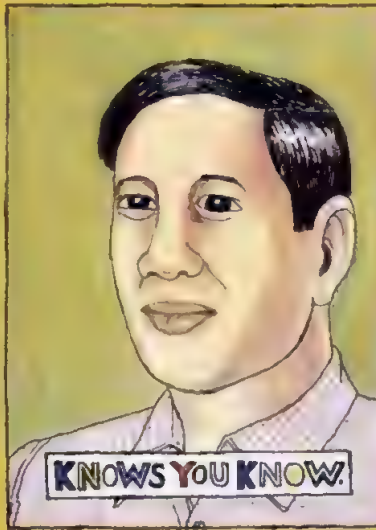
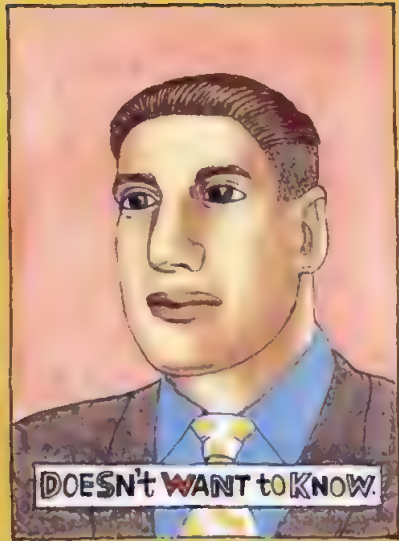
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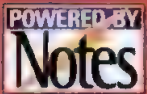
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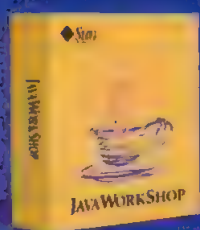
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Bot's search options have easy-to-use drop-down menus or radio buttons, and the interface lets you customize your search page and set your own defaults.

HotBot doesn't yet offer site content, such as news or subject categories, but Hotwired says to expect something soon. HotBot may be a newcomer to the Internet search-engine scene, but its youth belies its power.—*Nancy Sirapyan*

HotBot. Hotwired Inc., San Francisco; 415-276-8400; fax, 415-276-8499. Inktomi Corp., Berkeley, CA; 510-883-7300; fax, 510-883-7399. www.hotbot.com.

Infoseek Corp.

Infoseek

Novice Web searchers will appreciate Infoseek's uncluttered interface as well as the site's excellent basic search capabilities. During testing, it did a fair job when we entered vanilla single- and multiterm queries in the query window. But when we applied Infoseek's query customization syntax and recommended query style, our returns did not appreciably improve. Far more valuable were the Related Topics link accompany-



You can choose to search from a variety of databases with Infoseek.

ing most of the search returns and the Similar Pages link that is listed after every hit.

Infoseek's search engine has a claimed database of 1.5 million full-text-indexed pages. It ranks your hits in order of how often a word or phrase appears on a page and where it appears.

The interface does not provide you with a screen for advanced query building. The only selectable option is whether to search the Web, Usenet, or one of Infoseek's additional databases, which include Infoseek's list of recommended sites, a directory of company profiles, an

e-mail address directory through WhoWhere?, Web FAQs, and a selection of news wires. You construct advanced queries by adding symbols to your keywords. Infoseek does not use the common Boolean operators AND, OR, and NOT, or the NEAR proximity operator, but its symbols offer very close approximations.

Rather than forcing you to construct a keyword query, Infoseek also allows you to enter a natural-language phrase to explain what you want. While this approach greatly improves Infoseek's ease of use, we found that the results were no better than when we merely entered the keywords sequentially.

If you like serendipitous searches, you can browse Infoseek's 12-category Web Directory and drill down into hundreds of searchable subcategories. Each page in the Web Directory contains a list of recommended sites.

Infoseek Ultra, Infoseek's new proprietary engine, was in beta testing at press time and should be integrated into Infoseek by the time you read this. Ultra will expand Infoseek's claimed URL base to 50

SUITABILITY TO TASK

Infoseek

	Power	Ease
Simple searches	Good	Excellent
Custom searches	Fair	Good
Category searching	Fair	Good
Web content	Fair	Good

million and will offer domain and media searching. It will not include any Web pages that attempt to spam their way to a higher ranking with an inflated number of keyword references.—*Karen Bannan*

Infoseek. Infoseek Corp., Santa Clara, CA; 408-567-2700; fax, 408-986-1889; www.infoseek.com.

Lycos Inc.

Lycos

Lycos combines a huge claimed database of more than 66 million URLs with a proprietary technology that stresses the statistical analysis of page contents rather than brute-force full-text indexing. The result is a search engine that sometimes delivers results with im-



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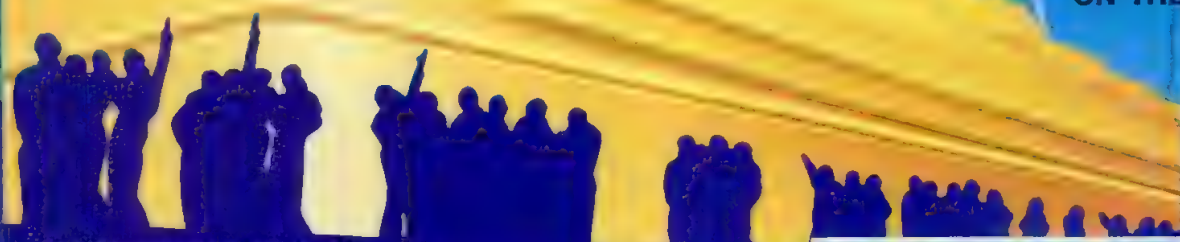
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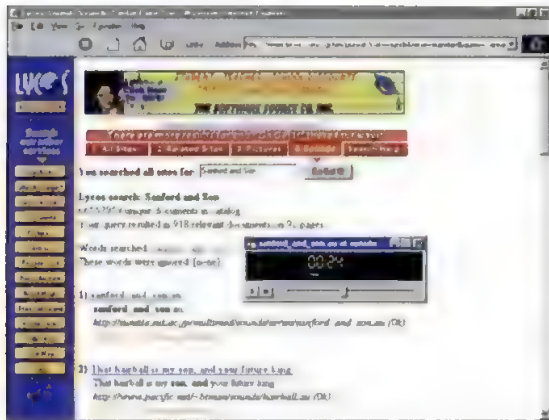
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INTERNET

Web Search Sites



When you search for sounds or pictures, Lycos retrieves them automatically.

pressive ease. But if you don't get exactly what you're looking for the first time, Lycos's weak customization features can make refining your search a tough, frustrating job.

Like many leading search sites, Lycos offers various types of attractive content, including news, site reviews, popular links, city maps, a people finder, and the ability to search the Web for images or sounds. Whether this content will actually justify frequent visits to Lycos is another question.

The simple design of the Lycos home page—a window for entering your search and a list box for focusing your search on the whole Web, on a group of sites categorized by subject, or on sites containing sounds or pictures—encourages you to perform simple searches. You simply type in search terms, which the engine treats as word stems.

Lycos ranks the returned results by relevancy using several criteria, including the number of search terms in a document's summary (listed with each hit), the proximity in a document of words in a specified phrase, and the position of terms within a document. Using a simple search, you can sometimes end up with exactly what you want. Unfortunately, we often found that results with high relevancy

rankings didn't provide the information we sought.

You can tune the results to some extent using operators. Adding a period to the end of a term disables stemming so that Lycos will return only an exact match of that term. A minus sign indicates a Boolean NOT, and a dollar sign acts as a wildcard. Lycos doesn't offer a "pages like this" option for using a hit as a query.

You can further customize your search by accessing the Custom Search page. Lycos does not support full Boolean

syntax, proximity operators, searches for exact phrases, or many other search features found in other tools. But the custom-query interface does let you specify basic AND or OR operators for the whole multiterm query, and you can request matches that have varying degrees of precision, from loose to strong (but not exact).

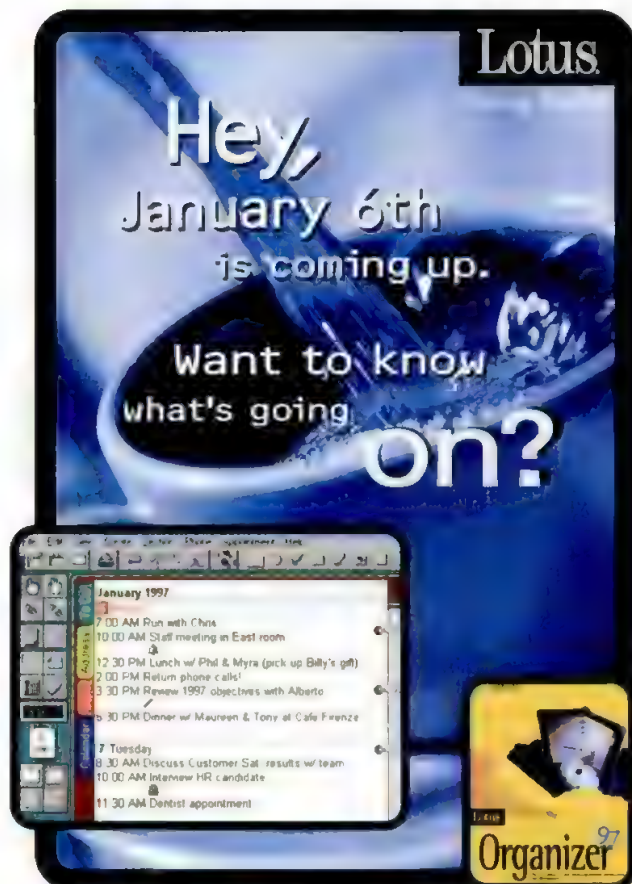
Happily, Lycos offers other ways to explore the Web. Best among these is its

multimedia catalog, which lets you find images and sounds on the Web. Lycos does not send you to the site containing the images, sounds, or videos you want; it brings the file to you when you click on a returned hit.

Lycos's Sites by Subject catalog lets you browse 16 categories that give you quick access to high-traffic sites (presumably the most popular ones). The Top 5% Sites reviews take the guesswork out of surfing, rating sites as to content, presentation, and the experience as a whole. Other services, such as PeopleFind and CityGuide, let you track down old friends, visit your old neighborhood, or investigate a new city before actually visiting it or moving there.

Lycos is a serious site that's definitely worth a bookmark. Stronger search customization options as well as an improved interface would encourage many more users to take advantage of its assets. —Sharon Terdeman

Lycos. Lycos Inc., Marlboro, MA; 508-229-0717; fax, 508-229-2866; www.lycos.com.



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SUITABILITY TO TASK

Lycos

	Power	Ease
Simple searches	Fair	Excellent
Custom searches	Fair	Good
Category searching	Fair	Excellent
Web content	Good	Excellent

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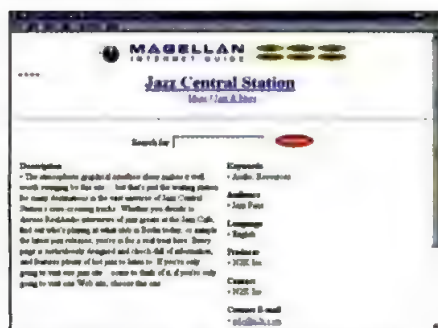
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Excite Inc.

Magellan Internet Guide

No one offers the comprehensive reviews and ratings of Internet sites that Magellan does. With more than 40,000 reviewed sites, including newsgroups and mailing lists in addition to Web sites, Magellan adds an impressive level of depth to its search capabilities. It performed poorly, however, on our test search queries. Using Magellan's advanced search options improved results, but the site is best suited for finding information on topics of a very general nature that it has reviewed.



Magellan's reviews are comprehensive and complete.

Magellan rates sites based on three criteria: depth, ease of exploration, and Net appeal. Search results are ordered by relevancy. Results returned from searches within Magellan's rated and reviewed sites offer a star rating, a green-light designation for sites with no adult-oriented material, the lead sentence or two from the review, and links.

At the top of the result page, Magellan displays a list of categories related to your search. The review offers a wealth of relevant material, including a pithy description and an evaluation of the site, keywords, the site's target audience, the content producer, e-mail and phone contacts, and pricing information.

Magellan offers two ways to find the site or review you're looking for: choosing

from a list of categories or running a search. Magellan divides its reviews into 26 categories. Instead of providing many levels of subcategories under each topic, as Yahoo! does, Magellan has only one level, quickly getting you to where you want to go.

If you use Magellan's search options, you can search either the rated and reviewed sites or the entire claimed database of 15 million URLs. You can choose to view only green-light sites, regardless of the database you search. You can also filter out sites rated lower than three stars from your returned results or ask to see only four-star sites.

Magellan also features some attractive extras. Its most intriguing offering is Search Voyeur, which shows you 20 live searches occurring across the Net at any time. Magellan also powers the *Rolling Stone Rock Guide* (www.rockguide.com) a searchable database of rock-site reviews. A Net Events feature fills you in on live Internet chats and broadcasts. Magellan by and large does one thing and does it well—providing in-depth reviews

and ratings for the Internet.—MM
Magellan Internet Guide. Excite Inc., Mountain View, CA; 415-331-1884; fax, 415-806-7889; www.mckinley.com.

Open Text Corp.

Open Text Index

Open Text Index, from Open Text Corp., does a good job of delivering relevant hits from simple keyword queries. In testing, we found that Open Text handled a literal search term, such as *Disney*, better than a conceptual one, such as *Reconstruction*; with the former type, Open Text consistently returned a good percentage of relevant hits within the first ten results. We found that custom searching, however, produced less impressive results.

The Open Text engine ranks hits according to a weighted relevance score. If a keyword appears in the URL, in the title, or in any first-level heading of a page, the score is higher than if the keyword appears in the body. When constructing queries, be careful not to add terms likely

SUITABILITY TO TASK		
Magellan Internet Guide		
	Power	Ease
Simple searches	Poor	Excellent
Custom searches	Good	Good
Category searching	Good	Good
Web content	Good	Excellent



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to appear in a title or heading (*home* or *Web*, for example), or you'll end up with a good number of irrelevant hits. Open Text does not support the weighting of keywords.

For performing simple searches, you have two options: keyword or phrase. Keyword searching performs an implied AND query with a multiple word query, while phrase searching treats a series of words as a single string. Open Text

Uniquely among the search engines reviewed here, Open Text has a mirror site in Japanese. Through a joint venture with AT&T, Spanish and Portuguese versions are available, too. If you are performing general searches on precise terms, Open Text is an above-average choice.—Arie Moller

Open Text Index. Open Text Corp., Waterloo, Ontario, Canada; 519-888-9910; fax, 519-888-0677; index.opentext.net.

GNN

WebCrawler

WebCrawler's simple interface belies a host of strengths, including a rich query-customization syntax and a good selection of site reviews. During testing, it sometimes delivered strong lists of relevant, up-to-date hits. When it didn't—and this is WebCrawler's significant downside—we found that even extensive tweaks to our queries often failed to improve the result.

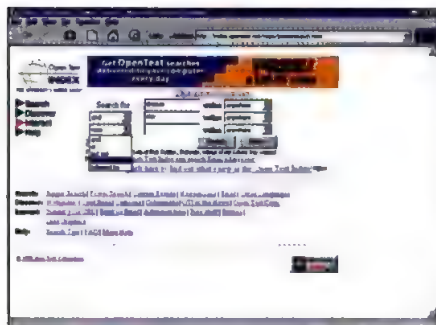
Boolean ORs implicitly join any search terms you enter into Web-



Click on one of WebCrawler's content areas to find capsule reviews of interesting sites.

Crawler's basic search window. Just by entering a few relevant keywords or a descriptive phrase, we were often able to generate a useful list of hits with few duplicates. WebCrawler uses a small icon next to each returned hit showing the site's approximate relevancy ranking. A Show Summaries option redisplay the page with a summary for each hit, its full URL, an exact relevancy ranking, and a Similar Pages option that uses the hit as a query by example via its keywords.

If you want to try refining a query, you



Open Text's interface delivers the full range of Boolean and proximity operators.

doesn't automatically parse keywords into word stems, nor does it offer a wildcard option. You need to place an OR operator between every variation you're looking for (for instance, *car* OR *cars*).

You don't need to enter operators manually to use Open Text's Power Search feature. The form-based interface provides drop-down pick lists for specifying Boolean (AND, OR, NOT) and proximity (NEAR, FOLLOWED BY) operators and the specific HTML page element you wish to scan (choices include Anywhere, Summary, Title, and First-level heading). The interface offers no means of creating nested Boolean searches, but Open Text does parse operators in the order they are entered. According to Open Text, the returned results page should feature a "find similar pages" option by the time you read this, but this option was not available to us during our testing period.

SUITABILITY TO TASK

Open Text Index

	Power	Ease
Simple searches	Good	Excellent
Custom searches	Fair	Good
Category searching	N/A	N/A
Web content	Fair	Good

N/A—Not applicable. The site does not offer this feature.

Lotus

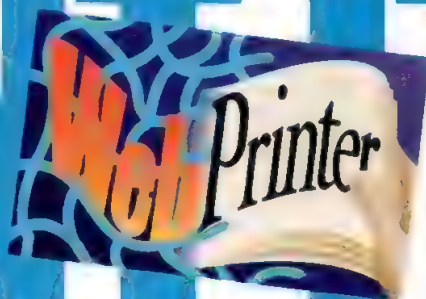
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SUITABILITY TO TASK

WebCrawler

	Power	Ease
Simple searches	Good	Good
Custom searches	Fair	Fair
Category searching	Good	Excellent
Web content	Good	Excellent

need to learn WebCrawler's query syntax, as the site does not provide a custom-query graphical interface. The syntax is straightforward and includes the usual Boolean AND, OR, and NOT; the NEAR proximity operator (which supports a switch indicating how close the match must be); parentheses for nested queries; quotation marks for phrase searching; and an ADJ operator, indicating that two words must appear together in the order entered.

In testing, we discovered that this powerful-looking set of operators often failed to deliver a better result set than a plain phrase. The engine does not support wildcards or keyword weighting, and it doesn't allow you to narrow your query by domain.

WebCrawler's categorized Web site reviews alone are worth a trip to the site. Clicking on any of the 15 content categories reveals multiple subcategories containing capsule reviews of a host of interesting sites. You can link to any of these sites directly or click a button to search for more sites covering a given topic. Other nice features include the 25 most linked-to sites and a ticker that lets you see live queries being entered by other users.

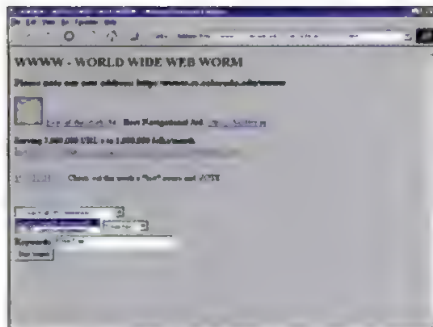
WebCrawler may not be your first choice for Web searching, but it's worth visiting nonetheless. Although query tweaking isn't its strong suit, some of your queries' returns will be uncannily accurate. —Thomas Mace

WebCrawler. GNN, Berkeley, CA; 510-883-7220; fax, 510-883-7222; www.webcrawler.com.

University of Colorado

World Wide Web Worm

A search site from Oliver McBryan of the University of Colorado at Boulder that only indexes hyperlinks, the contents of a page's Title tag, and the domain of the server containing the doc-



Simple and straightforward, Worm finds hyperlinks from its indexed pages.

ument, World Wide Web Worm is a little different from its competitors. But if your query has any likelihood of being referenced in a hyperlink or a title, Worm can reliably get you a result. Text associated with a graphic, as in the description of an HREF or in the IMG SRC tags, is given a high relevancy in Worm. The graphic and its source page are then both listed as your return.

You also receive an impressively low number of dead links, because the entire database is rewritten when Worm per-

forms a crawl for new URLs (about every two months). Our tests, however, did reveal a rather high percentage of duplicate links.

Defining a query is simple with Worm. You can select whether multi-term keywords will be treated as a logical AND or OR search. You cannot, however, create a custom query using multiple Boolean operators. You can choose to see 1, 5, 50, 500, or 5,000 responses, all on one page. Although limited, Worm will sometimes deliver what you're looking for. It's definitely worth a bookmark.

—Rick Rovegno

World Wide Web Worm. Oliver McBryan, Boulder, CO; www.cs.colorado.edu/www.

SUITABILITY TO TASK

World Wide Web Worm

	Power	Ease
Simple searches	Poor	Excellent
Custom searches	Fair	Good
Category searching	N/A	N/A
Web content	N/A	N/A

N/A—Not applicable. The site does not offer this feature.

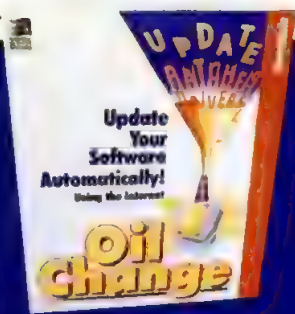
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Yahoo! Inc.

Yahoo!



More a master Web site directory than a search engine, Yahoo! was the first and remains the most popular of the search sites on the Web today. It's a solid starting point for any general Web search, because its extensive categorization system ensures that you'll find a good-quality site if Yahoo! has indexed



Yahoo!'s hierarchy of categories provides a logical way of getting information.

what you're looking for.

Yahoo! organizes Web content into 14 broad categories listed on its home page. Depending on the specificity of your search, you can either drill down through the categories to look at subcategories and listed sites, or search for specific words or terms across the entire database. You can also initiate a search within any section or subsection of Yahoo!, which runs your query only within that subset of the database.

Because the sites are categorized by human editors, the quality of the links is high. But if you don't find what you're looking for, Yahoo! offers only minimal tools for fine-tuning your search. They are provided through a graphical form that lets you specify basic Boolean AND and OR; you can also set your query to look for exact text or word stems. Yahoo! is integrated with the AltaVista search engine, so if your query fails at Yahoo!, it's automatically run again using the AltaVista

search engine links at the bottom of the returned results page.

When you run a search in Yahoo!, you'll first receive the categories into which your query has been placed. A list of Yahoo! sites follows, including the categories into which they've been organized. Finally, your query will be loaded into a text box ready to run in AltaVista, in case none of the leads proves fruitful. A search on *Robert Fripp*, for example, provides you with "Entertainment:Music:Artists:By Genre:Rock:Classic Rock:King Crimson:Fripp, Robert" as the Yahoo! category, with a list of sites following.

The obvious downside of limiting you to categories and site headers is that the result set is substantially smaller than what you'll get with other search sites in this roundup. When looking for a specific text string, Yahoo! performed poorly in our tests.

Yahoo! offers a wealth of extra services in addition to its Web index. You can send queries to Deja News to search Usenet news groups and to Four11 to locate e-mail addresses.

Yahoo! does a good job on its region-specific sites, and coverage includes both cities and countries. Yahoo!igans provides a subset of the Yahoo! index filtered to sites appropriate for children. Also notable is My Yahoo!, a customizable news page. Softbank, the parent company of *PC Magazine's* publisher, has a significant investment in Yahoo!

While Yahoo! fares poorly in searches for highly specific terms, its handcrafted category searching enables it to return high-quality information in general searches. Its integration with AltaVista and links to all other search sites on the Web make it a solid starting point for any Web search project.—AS□

Yahoo! Yahoo! Inc., Santa Clara, CA; 408-731-3300; fax, 408-731-3301. www.yahoo.com.

SUITABILITY TO TASK		
Yahoo!		
	Power	Ease
Simple searches	Good	Excellent



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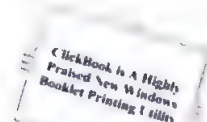


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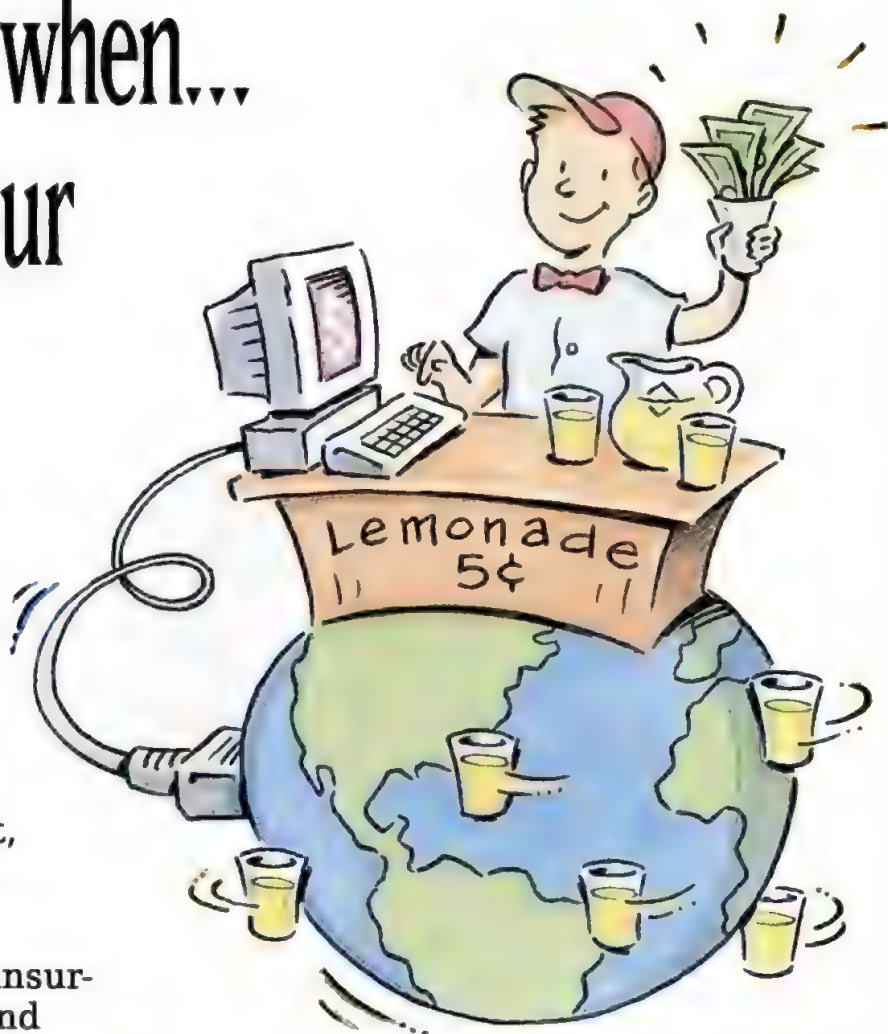
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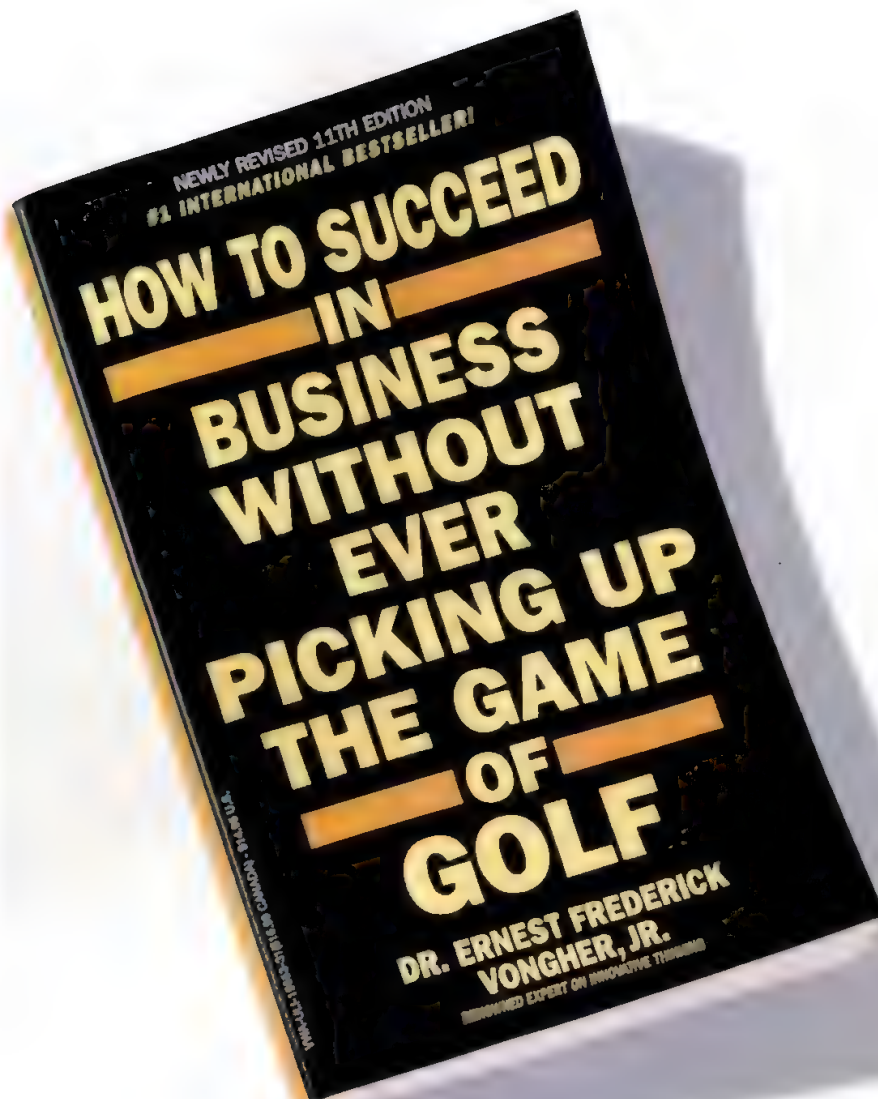
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The buzz right now for mainstream graphics accelerators is 3-D capabilities at no extra cost. But do you get what you pay for?

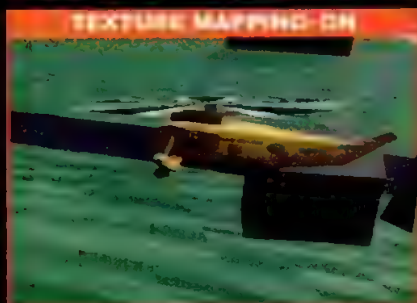
By Jeff Mace

The new breed of mainstream graphics boards comes with an added dimension: the ability to render and accelerate 3-D images. Three-dimensional graphics are largely the province of PC games right now. But throughout the coming 18 months, expect to see general-purpose applications—Web browsers, presentation packages, spreadsheets, and eventually even operating system user interfaces—start to offer 3-D components. Since the first wave of 3-D-capable accelerator boards offer better Windows acceleration than their 2-D-only counterparts of a year ago—and at the same price—it makes sense to consider a 3-D board now, even if you're not a games enthusiast—and even though the present 3-D capabilities are not yet fully what we would like to see.

We live in three-dimensional space, and the third dimension

Our Contributors: JEFF MACE is a project leader at PC Magazine Labs and was in charge of testing for this story. JAN OZER and WINN L. ROSCH are contributing editors of *PC Magazine*. JON HILL and LINDA and ERICK VON SCHWEBER are frequent contributors to *PC Magazine*. ROB GLIDDEN is a senior contributing editor of *Wave*, a newsletter that covers 3-D and media technologies. JAMIE M. BSALES was the associate editor in charge of this story.

Texture mapping applies bitmapped texture images that are stored in memory to objects in the scene, almost like wallpaper, to add realism. This lets you add effects like the decals on the helicopter, the brick texture of a wall, and so on.



Bilinear and trilinear filtering smooth textures in a scene to lessen the blocky effect. With MIP (multim in parvum) mapping, an application provides several different resolutions of the texture for objects as they move closer or farther in the scene.



Perspective correction rotates the texture bitmaps to give a better sense of convergence. In this way, renderings of continuous elements, such as a brick wall or a meadow, maintain a realistic look as they recede from the viewer.



ADDITIONAL 3-D RENDERING TERMS **Flat shading** is a technique where an entire triangle is a single color. It creates a blocky effect because there is no smooth blending of colors. **Gouraud shading** is a more advanced shading method that improves overall

appearance, allowing curves and contours to be more rounded.

Z-buffering tracks the depth of each triangle's vertices from the viewer's perspective and sorts the triangles to ensure that objects that fall in front are the only ones drawn.

is depth. We know what is up, down, left, right, close, and far. We know when something moves toward us, or moves away. The traditional PC interface, however, makes use of only two dimensions. True 3-D does not exist in business applications today, although some add touch-

es—such as a drop shadow around a button that makes it look pressed—to give some sense of depth.

Real 3-D on a computer, however, is a thing of movement. A 3-D application allows you to immerse yourself in a world that plays by the same rules as everyday

human 3-D experience. In life, you can see the back or side of something simply by walking around it. In a 3-D application, your monitor is your viewport into the computer's 3-D world. Since the computer has no idea of how you might plan to move, it sits ready to render for you, in

HIGHLIGHTS

Mainstream Graphics Accelerators

Mainstream graphics-card buyers are being lured by the latest wave of products: cards that offer acceleration of the 3-D graphics in games, VRML browsers, and other programs. But it's still very early in the lives of 3-D APIs and hardware. Products will evolve a great deal in coming months.

Three-dimensional graphics in mainstream applications is an idea whose time has come. True 3-D, in which users will be able to immerse themselves in 3-D screen images and seemingly move around and view objects, will add a new level of

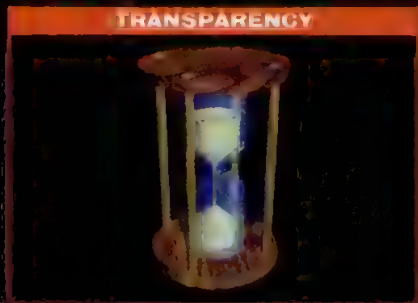
functionality to many programs. Shoppers might visit 3-D stores online and stroll the aisles instead of scrolling through flat home pages. Spreadsheets and databases might make data more accessible by letting you rotate charts to view them from any angle. Games would look more realistic.

There are still relatively few applications that use 3-D graphics, however. Several dozen games are out there, as are a few VRML toolkits and browsers that let users create and visit 3-D "home worlds." Mainstream business applications—spreadsheets,

presentation packages, databases—won't offer 3-D graphics until sometime in 1997, a fact that limits the appeal of the current 3-D hardware.

So for purchases at this time, it's best to focus on the traditional graphics-accelerator attributes. Look for outstanding 2-D performance, support for the resolution and color depth you use (or plan to use after buying a larger monitor), and intuitive control utilities. We found boards that deliver all this—plus respectable 3-D acceleration, helpful for games or VRML—at a very reasonable \$200 street price.

Atmospheric effects, such as fog and lighting cues, are supported by most 3-D chips. Alpha blending is a way of allowing one object to show through another to create a sense of transparency, as in the hourglass seen below.



We used Datapath's Realimation (Space-Time Editor) as an inspection tool to gauge rendering quality for Direct3D effects, as shown in the scenes here.

real-time, the effects of your movements, usually made with a mouse, a joystick, or a VR headset. And it manages every element in its 3-D world in such a way as to keep you believing you are really in a three-dimensional space.

With that added dimension, many applications would become more inviting and useful. Games would look more realistic; businesses could create virtual "worlds" online for customers to tour, instead of flat home pages you scroll through; business professionals could generate more compelling presentations, with the look and feel of a Hollywood feature; user interfaces could zoom idle application windows off into the distance. Some of this is just showing off, some of it useful, and some is worth doing just because—well, because now you can.

The problem at the PC level has been computing horsepower. A 3-D scene requires constant updating as you navigate through it. Each of the objects must con-

tinually go through transformations in depth space, known as the *z-axis*, on an *x, y*-coordinate plane.

As objects move, the system needs to track what has moved where, and which objects have become partially hidden from view. For example, as a warrior in a game moves into the distance, it gets smaller and smaller. The warrior is a complex geometric object, made of a series of polygons, that changes in size and clarity as it moves. At close range, you can see the textures of its clothing and armaments (thanks to *texture mapping*). As it moves, the lighting changes, as does the clarity of other elements in the view. For the movement to look real, *rendering* (drawing the images

Editors' Choice

- Business graphics: Diamond Stealth 3D 2000XL
- 3-D graphics: Intergraph Reactor



If you want a graphics accelerator that delivers the perfect combination of 2-D performance and 3-D speed and visual quality, you'll have to wait another

six months. For now, you're better off focusing on features other than 3-D performance, such as 2-D GUI acceleration, since those will matter much more until mainstream 3-D programs arrive in significant numbers.

But those who want to dabble in 3-D now are in luck: The best-performing 2-D graphics accelerator in this roundup, the Diamond Stealth 3D 2000XL (\$180 street with 4MB of RAM), delivers respectable 3-D acceleration and wins our Editors' Choice. The product is based on S3's popular ViRGE 2-D/3-D chip. Diamond has done a good job of optimizing the standard ViRGE drivers, and the Stealth topped all other cards we tested on our new WinMark 97 and Winstone 97 tests, which assess performance on typical business applications. The card's 3-D test results were good though not spectacular.

The best-performing board on our 3-D measures is Intergraph's Reactor (\$180 street with 4MB of RAM). If you are interested in an accelerator primarily for 3-D apps, this is the board to buy right now. The Reactor posted higher frame rates than the other 3-D boards on most of

our tests. More importantly, its Rendition Verite 1000 chip supports the widest range of advanced 3-D features and effects, and the visual quality and accuracy of 3-D scenes were far superior to those rendered by other chips. The Reactor's 2-D performance was acceptable.

An honorable mention goes to the ATI 3D Expression+ PC2TV (\$190 street). Equipped with ATI's own RageII 2-D/3-D chip, it delivered solid 2-D and 3-D performance and excellent video playback. The quality of its 3-D renderings was second only to the Reactor's. ATI's fine display utilities and extra features—such as video-out, which lets you display a computer image on a television set—make the Expression+ a compelling choice.

Other boards in this roundup are worthy of your attention. Business users should look closely at the Matrox Millennium (\$270 street), a past Editors' Choice winner that is now just a step behind newer offerings. Number Nine's Imagine 128 Series 2e (\$330 street) delivers good performance and the best utilities in the business. The Hercules Terminator 3D (\$199 list) offers respectable 2-D and 3-D acceleration for business and home users.

on-screen) these changes must happen at least 15 times per second. Television delivers 30 frames per second (fps), and movies deliver 24 fps.

REVIEW CRITERIA

For this roundup we tested 23 PCI-bus graphics boards new to the market since our mainstream roundup a year ago. To be included, a board had to deliver Windows 2-D or 2-D and 3-D acceleration at 1,024-by-768 resolution and 16-bit color depth (that is, 654,000 colors, also called *high color*) with a vertical refresh rate of at least 75 Hz (the current minimum refresh-rate standard endorsed by the Video Electronics Standards Association). The board

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	Direct 3D Speed Test	Direct 3D Game Speed	Full PCI Bus Mastering	Two True Perspectives Correct Texture Mapping
Matrox Mystique				
ATI 3D Xpression	25	NA		
Diamond Stealth 3D 2000XL	23	14		✓

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All Winbench 95 and Direct 3D tests conducted on Sept. 6, 1995 by Matrox Graphics Inc. on a Gateway P5-100 configured with Intel P5 166MHz, 16MB of EDO RAM with 2MB cache. The Matrox Millennium and Matrox Mystique 128 Series 7 were configured with 4 MB of memory using driver releases 3.12 and 3.29 respectively. The STB Lightspeed 128 was configured with 2.75 MB of memory using driver release 1.72, and could not be expanded to support 1024 x 768 or 24-bit Matrox Mystique. Diamond Stealth 3D 2000XL and ATI 3D Xpression were configured with 2 MB of memory for the PC bus using driver releases 3.12, 4.02 (B, 2.01) and 3.22 respectively for Windows 95. Winbench 95 1.0 tests conducted at 1024 x 768 resolution with 8 bit and 24 bit color at 75Hz refresh using target fonts under Windows 95. ATI has not released Direct

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30 drivers for the 3D Xpress—therefore drivers provided to the Microsoft DirectX 7.0 SDK were used. © Monster Truck Madness: Microsoft Corp. Monster Truck Madness was tested in first person view, with disabled off-map off-sightline on horizon to remove effects on image quality; high texture normal, geometry, and shadow normal, prioritizing on the tracks and particles. Tests conducted at 640 × 400, 800 × 480, 1024 × 768. 3D Xpress tests done using frame from the DirectX 7.0 SDK. Diamond Dream 3D 20000:™ and AT 3D Xpress tests were conducted at 512 × 384, 1024 × 768. White Matrix Mystique tests were conducted at 640 × 400. 16-bit based on GammaLab shaded perspective control textured, point sampled. 16-bit per pixel, color, digital rendered polygons. 17) Gamma Lab when executed on AT 3D Xpress.

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Mainstream Graphics Accelerators

had to be available to end users for a price of less than \$400 list. We also required that products be FCC Class B—certified with at least 2MB of display memory and that they deliver hardware-assisted video acceleration and scaling, plus hardware- or software-based MPEG decoding.

With the recent drop in memory prices, and because of the memory requirements of 3-D, we think you should consider 4MB boards now. The price difference between a board equipped with 2MB of memory and one with 4MB is only about \$40 (compared with \$100 a few months ago), and the extra memory lets you maintain high color depth at higher resolutions, which most users of 17-inch and larger displays will want.

CARDS AND CHIPS

Hardware and API developers have been working on solutions to enable a standard PC to deliver the functions needed for 3-D rendering inexpensively, and 13 of the accelerators in this roundup deliver 3-D functionality. The other 10 are traditional 2-D Windows accelerators that are still on the market. Note that such 2-D-only



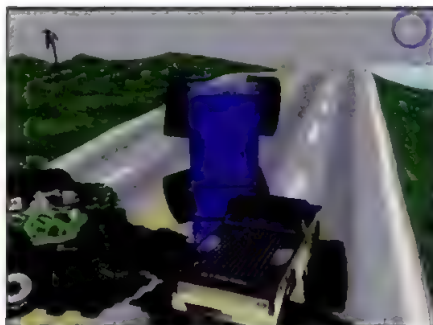
Three-dimensional "home worlds" are more inviting than 2-D home pages.

boards are a dying breed: Major chip manufacturers are dedicating most production to their newer 2-D/3-D designs, so as the supply of 2-D chips dries up early next year, most board makers will switch to 3-D-capable offerings. Still, some PC users might find a 2-D board fine for their purposes over the coming 12 months.

Just as important as the board vendors are the chip companies working behind the scenes to bring 3-D to the fore. S3's popular ViRGE chip is on ten of the boards in this review, ATI's RageII appears on its 3D Xpression+ PC2TV, the Matrox Mystique uses the company's MGA-1064SG,

and the Intergraph Reactor is based on Rendition's Verite 1000 controller.

Other vendors are gearing up with 3-D products, and the product landscape will change considerably in the coming months. The Verite 1000 chip that powers Inter-



Games (such as *Monster Truck Rally*, shown here) look more realistic in 3-D.

graph's Reactor is getting around. Creative Labs has announced its new 3D Blaster PCI, based on Verite, and Sierra Games is putting its full support behind the Rendition chip to the extent of selling its own Verite-based boards. S3 has released the ViRGE VX, a VRAM version of its 2-D/3-D chip that interfaces with a 220-MHz RAMDAC. STB will offer its Velocity 3D board, based on the VX, and Diamond will extend its Stealth 3D line with the 3000, which also features this chip.

The 3Dfx Voodoo chip set is the processor eagerly awaited by the gaming community. That chip set will be found on add-in boards to supplement an existing 2-D or 2-D/3-D graphics card, connected by an external VGA passthrough cable. Orchid will offer its Voodoo-based Righteous 3D board for \$299, featuring 4MB of memory. Diamond Multimedia will release the Monster 3D board, with 4MB of EDO RAM, also for \$299. NEC and VideoLogic have sought to create a modular 3-D chip architecture, PowerVR, that minimizes memory use. The chip's Infinite Planes architecture does away with z-buffer memory. PowerVR is highly scalable; multiple chips can be ganged together for enormous performance boosts. Compaq has announced support for PowerVR in its Presario 8000 series, and Sega, Namco, and other game companies have proclaimed their support for the chip.

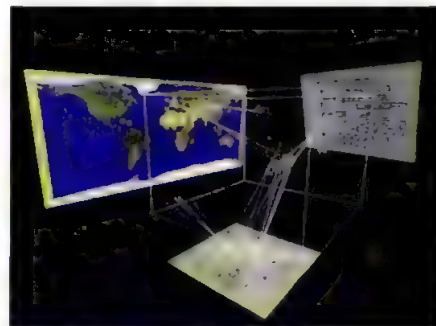
Cirrus Logic has recently announced its Laguna 3D chip, which uses a texture-management scheme instead of a triangle-

setup engine. The 3Dlabs Permedia will be found on many vendors' forthcoming boards, including Diamond Multimedia's FireGL 1000. Each of these will feature the Delta triangle setup chip (reducing the load on the host CPU) and include drivers for both Windows 95's Direct3D and Windows NT's OpenGL.

THE API CONNECTION

Hardware vendors are not the only ones conspiring to bring 3-D to your desktop. A second piece of the puzzle is the *application programming interface* (API), a toolkit and set of guidelines that developers can use for creating applications under a particular operating system. Microsoft was painfully aware of Windows' limitations not only for 3-D software, but also for multimedia CD-ROM titles using digital video. Unlike DOS, where the software developer could get directly at the graphics hardware, Windows requires all graphics operations to go through the GDI (Graphics Device Interface). That's good for word processors, but bad for anything that puts successive frames on the screen.

Microsoft came up with strategies to



This app (courtesy of Battelle PNNL and Sense8) shows the potential that 3-D holds for business.

solve this problem that eventually evolved into what is now known as *DirectX*, a set of Windows operating system extensions housing several APIs that enable application developers to get directly at the hardware. Any PC user running Windows 95 has DirectX support through software; you do not need special hardware. But to get the best performance, a graphics card that supports some DirectX features is the better way to go.

DirectDraw (originally known as DCI, or Display Control Interface) was the first component of DirectX to be released. It allows the fast writes to hardw

Mainstream Graphics Accelerators

video requires. DirectPlay, DirectSound, and DirectInput came next, all of which add functionality to games by allowing the use of joysticks without increasing CPU utilization, producing better sound with low-latency mixing and hardware acceleration through direct hardware access, and enabling game-playing over modem lines, respectively.

Microsoft's 3-D graphics API was mostly derived from its acquisition of RenderMorphics, developers of the Reality Lab 3D SDK (software development kit), which was incorporated into the overall Direct3D architecture. Since Direct3D was released in June of this year, chip vendors, already well into the development cycle, had to provide their own proprietary solutions for bringing its 3-D rendering aboard their chips or risk missing the 3-D boat.

As 3-D chip sets began to appear over the past few months, the graphics board vendors set their sites on this potentially new Windows market. By using Microsoft's DirectDraw API, their accelerator hardware could enable popular DOS titles to run under Windows for the first time. Companies like ATI, Matrox, and S3 developed their own SDKs to allow games to be directly ported to work with their chips (and their chips only) under Windows.

Microsoft hastened the release of the Direct3D SDK in order to be in time for the 1996 holiday market, and the product is ready and awaiting use by potential vendors as of this writing. But software developers haven't jumped on board so quickly. Many in the industry believe that Direct3D needs better documentation, and most current 3-D chips were not designed with Direct3D in mind.

Apple, too, is entering the fray with its own 3-D API: QuickDraw 3D Rave. The company hopes its API will gain popularity on the PC side, as its QuickTime video standard has. The Apple architecture may be more extensible than the current Microsoft API, because its approach lets developers plug in their existing rendering engines to maintain an application's unique look and feel. And Apple is working on a plug-in software module that will utilize any Direct3D-compliant graphics board to help accelerate QuickDraw 3D functions. Right now, though, there are only a handful of QuickDraw applications written for the PC.

FROM HERE TO 3-D

The final piece to fall into place will be the application software. Several dozen games are available now that deliver 3-D graphics. For business users, though, there is virtually nothing. Direct3D-enabled Web browsers have appeared, which let you tour the handful of VRML-based 3-D "home worlds" that have cropped up online, but the major developers' bread-and-butter applications—presentation packages, spreadsheets, and databases—are still 2-D only. The 1997 releases of Microsoft Excel, PowerPoint, and Word will incorporate some minor 3-D graphics features. Expect to see



Speed vs. Accuracy: The differences in Direct3D rendering are noticeable. The top scene was rendered by the Matrox Mystique, which trades accuracy for speed. The bottom one was rendered by the Intergraph Reactor, which delivered the intended filtering and fog effects.

more applications adopt 3-D as the hardware spreads in the mainstream and as developers learn how to incorporate the new dimension to enhance functionality.

3-D may show up in the simplest form, as bells and whistles added to existing applications (imagine animated sprites or help agents). In the not-too-distant future, expect your spreadsheet's 3-D bar charts to be more like towers that you can drive around or fly above. You'll also go online to browse in virtual stores, where you can walk the aisles and look at the merchandise from all angles. And imagine being able to

see exactly how to put together the outdoor gas grill you just purchased in real-time 3-D animation, instead of just looking at an indecipherable 2-D instruction sheet.

NOT CREATED EQUAL

The 3-D chip sets represented here and the ones still to come vary in their abilities and implementations of features, and that will affect the quality of their renderings on-screen. One constraint the chip designers had to keep in mind was price: More features require more memory, and hence greater cost, which could push a board out of the \$200-to-\$300 price bracket targeted for the typical business and home user. Since initial design stages, memory prices have fallen dramatically, but chip designers could not have foreseen that change.

As a result, we see some vast differences in features on some of the products reviewed in this roundup. For example, the full-featured (but memory-hungry) Verite 1000 chip on Intergraph's Reactor supports every 3-D filtering mode and even has an onboard RISC processor to handle *triangle setup*, a part of the 3-D graphics processing pipeline that has a heavy impact on system performance if done by the CPU. Under the old memory price structure, the 4MB Reactor would have been deeply undercut in the market by 2MB boards based on less ambitious 3-D chips; now it can sell for \$180—less than several boards based on other chips.

Other chips in this review have their own unique strengths. ATI's Rage II, for example, supports *video out*, which means you can display your PC's screen image on any television. The Rage II also supports all texture modes, like the Verite 1000, but lacks a triangle-setup engine.

S3's ViRGE chip does not offer triangle setup, but it supports everything else, including flat and Gouraud shading, texture mapping, bilinear and trilinear filtering, MIP mapping, perspective correction, depth cueing, fogging, alpha blending, and z-buffering (see the sidebar "3-D Terms: A Visual Glossary" for definitions). Like other chips, the ViRGE allows applications to use video as a texture map, and S3's traditional video-handling prowess may give the ViRGE an edge.

The Matrox Mystique's chip set has a shorter list of 3-D features: no bilinear or trilinear filtering and no scene enhance-

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SUMMARY OF FEATURES

Mainstream Graphics Accelerators

PC MAGAZINE
EDITOR'S CHOICE

■ YES ■ NO

Products listed in alphabetical order

	Appian Jeromino J1	ATI 3D Xpression+ PC2TV	Diamond Stealth 3D 2000XL	ELSA Victory 3D	Genoa Phantom 3D	Hercules Dynamite 128/Video
List/street price	\$249.00, \$230	\$199.00, \$190	\$200.00, \$180	\$329.00, \$280	\$269.00, \$240	\$129.00, \$120
Graphics accelerator chip	Cirrus Logic CL-GD5462 VisualMedia	ATI Rage II	S3 ViRGE	S3 ViRGE	S3 ViRGE	Tseng Labs ET6000
Display memory (tested unit)	4MB RDRAM	4MB SDRAM	4MB EDO DRAM	4MB EDO DRAM	4MB EDO DRAM	2MB MDRAM
Maximum installable memory	4MB RDRAM	4MB SDRAM	4MB EDO DRAM	4MB EDO DRAM	4MB EDO DRAM	4MB MDRAM
VGA pass-through connector	■	■	■	■	■	■
TV tuner	None	\$129	None	None	None	None
MPEG daughtercard	None	None	None	None	Info not available	None
Radio tuner	None	None	None	None	None	None
Other add-on options	Dual-monitor daughtercard	None	None	None	None	None
Display Characteristics						
Maximum noninterlaced graphics resolution (dpi)	1,600 x 1,200	1,600 x 1,200	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
Maximum number of colors at:						
1,600 x 1,200	256	65,000	N/A	256	32,000	256
1,280 x 1,024	65,000	16.7 million	65,000	256	32,000	65,000
1,024 x 768	16.7 million	16.7 million	16.7 million	65,000	16.7 million	16.7 million
800 x 600	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
640 x 480	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
Software						
Drivers for Windows 3.x/95/NT	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Drivers for OS/2, AutoCAD	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Other CAD drivers	MicroStation	None	ADI, MicroStation	None	MicroStation	None
Dialog box to change resolution	■	■	■	■	■	■
Dialog box to change refresh rate	■	■	■	■	■	■
Supports hardware zoom (largest zoom factor)	■ (4X)	■ (5X)	■ (6.25X)	■	■	■ (8X)
Supports virtual display	■	■	■	■	■	■
3-D Functions						
Dynamic Memory Allocation for z-buffer support	N/A	■	■	■	■	N/A
Texture memory/Frame-buffer memory	N/A	■ ■	■ ■	■ ■	■ ■	N/A
Supports double-buffering	N/A	■	■	■	■	N/A
Supports triangle primitives/triangle strips	N/A	■ ■	■ ■	■ ■	■ ■	N/A
Supports Chroma Keying	N/A	■	■	■	■	N/A
Texture modes:						
Point sampling (or pick nearest)	N/A	■	■	■	■	N/A
Bilinear filtering	N/A	■	■	■	■	N/A
MIP mapping	N/A	■	■	■	■	N/A
Trilinear MIP mapping	N/A	■	■	■	■	N/A
Perspective texture correction	N/A	■	■ (16-bit only)	■	■	N/A
Palletized textures	N/A	■	■	■	■	N/A
Texture compression	N/A	■	■	■	■	N/A
Atmospheric effects:						
Fog	N/A	■	■	■	■	N/A
Transparency (alpha blending)	N/A	■	■	■	■	N/A
Transparent texture mapping	N/A	■	■	■	■	N/A
Shading:						
Dynamic flat shading	N/A	■	■	■	■	N/A
Gouraud shading	N/A	■	■	■	■	N/A
Customer Support						
Toll-free technical support	■	■	■	■	■	■
Technical-support hours (eastern time)	11:00–8:00 M–F	9:00–7:00 M–F	8:00–10:00 M–F, 11:00–7:00 Sat.	10:00–8:00 M–F	11:00–8:00 M–F	9:00–9:00 M–F
Web address	www.appiantech.com	www.atitech.ca	www.diamondmm.com	www.elsa.com	www.genoasys.com	www.hercules.com
Warranty	2 years	5 years	5 years	3 years	2 years	5 years

N/A—Not applicable: The product does not have this feature.

Mainstream Graphics Accelerators



PC MAGAZINE
EDITORS' CHOICE

DECEMBER 3, 1996 PC MAGAZINE 273

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Processor	100MHz Pentium®	133MHz Pentium	200MHz Pentium Pro
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Hard Drive	630MB	1.2GB	2.5GB and 8X CD-ROM
Cache Internal	16KB	16KB	16KB
Cache External	256KB Write Back (optional)	256KB Write Back	256KB
Video Memory/Max.	1MB/2MB EDO	1MB/2MB EDO	2MB/8MB
Video Graphics	PCI Local Bus	PCI Local Bus	Matrox MGA Millennium
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
Expansion Slots/Drive Bays	5/5 Desktop	5/5 Desktop	5/5 Minitower
Ports: Serial/Parallel	1/1 (ECP)	1/1 (ECP)	1/1 (ECP)
Security Features	Yes	Yes	Yes
Processor Upgradable	Yes	Yes	Yes
Software Pre-installed	Windows® 95 or Windows 3.1	Windows 95 or Windows 3.1	Windows NT Workstation on CD-ROM
Limited Warranty†	3-Year	3-Year	3-Year
Price* (monitor not included)	\$1,139	\$1,679	\$3,419



*All prices shown are Compaq DirectPlus prices and do not include monitors. Reseller prices may vary. Other models available; call for pricing. Call for lease prices. Leasing is provided for a term of 36 months and is subject to approved credit and certain terms and conditions. Call for details. †Deskpro is covered by a Three Year Limited Warranty. Restrictions and exclusions apply. Some monitors and certain options are covered by a One Year Limited Warranty. Call for details. Offer available in the U.S. only. ©1996 Compaq Computer Corporation. All rights reserved. Compaq and the Compaq Logo registered U.S. Patent and Trademark Office. Deskpro is a registered trademark and DirectPlus is a registered service mark of Compaq Computer Corporation. Products, prices and programs are subject to change without notice. The Intel Inside Logo, Pentium, and Pentium Pro are registered trademarks and the Pentium Processor Logo is a trademark of Intel Corporation. Windows is a registered trademark of Microsoft Corporation. Other products are trademarks or registered trademarks of their respective companies.

SUMMARY OF FEATURES

Ends

Mainstream Graphics Accelerators

■ YES ■ NO

Products listed in alphabetical order

	Number Nine Imagine 128 Series 2e	Number Nine 9FX Reality 332	Orchid Fahrenheit Video 3D	Quadrant Bell Office Choice 6000+	Spider Lynx 64/V	Spider Tarantula 3D	STB Lightspeed 128	VideoLogic GrafixStar 600
List/street price	\$349.00, \$330	\$159.00, \$150	\$239.00, \$170	\$229.95, \$220	\$65.00, \$55	\$145.00, \$140	\$199.00, \$180	\$169.00, \$160
Graphics accelerator chip	Number Nine Imagine 128 Series 2	S3 ViRGE	S3 ViRGE	S3 Vision 968	IGS 1682	S3 ViRGE 325	Tseng Labs ET6000	Tseng Labs ET6000
Display memory (tested unit)	4MB EDO DRAM	2MB EDO DRAM	2MB EDO DRAM	4MB VRAM	2MB DRAM	4MB EDO DRAM	2.25MB MDRAM	2MB MDRAM
Maximum installable memory	4MB EDO DRAM	2MB EDO DRAM	2MB EDO DRAM	4MB VRAM	2MB DRAM	4MB EDO DRAM	2.25MB MDRAM	4MB MDRAM
VGA pass-through connector	■	■	■	■	■	■	■	■
TV tuner	None	\$79	None	None	\$75	\$75	\$99	None
MPEG daughtercard	None	None	Info not available	None	None	None	None	None
Radio tuner	None	\$79	None	None	None	None	\$99	None
Other add-on options	None	None	None	None	None	None	None	PowerVR 3-D
Display Characteristics								
Maximum noninterlaced graphics resolution (dpi)	1,600 x 1,200; 1,920 x 1,080 (Windows NT)	1,280 x 1,024	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200	1,024 x 768	1,280 x 1,024	1,600 x 1,200
Maximum number of colors at:								
1,600 x 1,200/1,280 x 1,024	256/256	N/A, 256	256/256	32,000, 65,000	256/256	256/65,000	N/A, 256	256/256
1,024 x 768	65,000	65,000	65,000	16.7 million	65,000	16.7 million	65,000	65,000
800 x 600	16.7 million	6.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
640 x 480	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
Software								
Drivers for Windows 3.x/95/NT	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Drivers for OS/2, AutoCAD	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Other CAD drivers	MicroStation, 3D Studio	None	None	MicroStation, 3D Studio	None	None	None	None
Dialog box to change resolution	■	■	■	■	■	■	■	■
Dialog box to change refresh rate	■	■	■	■	■	■	■	■
Supports hardware zoom (largest zoom factor)	■ (8X)	■ (4X)	■ (5X)	■	■	■ (3X)	■ (32X)	■ (5X)
Supports virtual display	■	■	■	■	■	■	■	■
3-D Functions								
Dynamic Memory Allocation for z-buffer support	■	■	■	N/A	N/A	■	N/A	N/A
Texture memory/Frame-buffer memory	■ ■	■ ■	■ ■	N/A	N/A	■ ■	N/A	N/A
Supports double-buffering	■	■	■	N/A	N/A	■	N/A	N/A
Supports triangle primitives/triangle strips	■ ■	■ ■	■ ■	N/A	N/A	■ ■	N/A	N/A
Supports Chroma Keying	■	■	■	N/A	N/A	■	N/A	N/A
Texture modes:								
Point sampling (or pick nearest)	■	■	■	N/A	N/A	■	N/A	N/A
Bilinear filtering	■	■	■	N/A	N/A	■	N/A	N/A
MIP mapping	■	■	■	N/A	N/A	■	N/A	N/A
Trilinear MIP mapping	■	■	■	N/A	N/A	■	N/A	N/A
Perspective texture correction	■	■	■	N/A	N/A	■	N/A	N/A
Palletized textures	■	■	■	N/A	N/A	■	N/A	N/A
Texture compression	■	■	■	N/A	N/A	■	N/A	N/A
Atmospheric effects:								
Fog	■	■	■	N/A	N/A	■	N/A	N/A
Transparency (alpha blending)	■	■	■	N/A	N/A	■	N/A	N/A
Transparent texture mapping	■	■	■	N/A	N/A	■	N/A	N/A
Shading:								
Dynamic flat shading	■	■	■	N/A	N/A	■	N/A	N/A
Gouraud shading	■	■	■	N/A	N/A	■	N/A	N/A
Customer Support								
Toll-free technical support	■	■	■	■	■	■	■	■
Technical-support hours (eastern time)	8:00-7:00 M-F	8:00-7:00 M-F	10:00-8:00 M-F	9:00-8:00 M-F	8:30-4:30 M-F	8:30-4:30 M-F	9:00-7:00 M-F	11:00-7:30 M-F
Web address	www.nine.com	www.nine.com	www.orchid.com	www.quadrantinc.com	www.spdi.com	www.spdi.com	www.stb.com	www.videologic.com
Warranty	5 years	5 years	2 years	2 years	2 years	5 years	Lifetime	5 years

N/A—Not applicable. The product does not have this feature.

Mainstream Graphics Accelerators

ments like fog or alpha blending. Matrox sacrificed those visual niceties for speed: The simpler rendering lets the Mystique deliver high frame rates, which is important for the popular game shoot-'em-ups.

2-D STILL PARAMOUNT

With all the hullabaloo surrounding 3-D, it's easy to bicker over the gravy and burn the roast: 2-D graphics acceleration. While we will need good 3-D features and functions for some applications, most of our computing lives will be spent in the 2-D GUI world. When you consider a board, look hard at its 2-D performance.

It seems all the 3-D chip designers did their homework when it comes to 2-D: On our tests, the new chip sets generally provide better acceleration than the older 2-D-only designs. (In this issue, *PC Magazine* rolls out its new graphics performance benchmark tests, Winstone 97 and WinMark 97, developed by Ziff-Davis Benchmark Operations. See the Lab Notes column in the PC Tech section for a complete explanation of the new tests and what they measure.) Of the boards we tested, the Stealth 3D 2000XL from Diamond Multimedia delivered the best 2-D acceleration; it is an Editors' Choice.

If you're buying a board for a machine that will see its fair share of 3-D apps, you can trade some 2-D acceleration for 3-D prowess. Of the boards in this review, Intergraph's Reactor delivered the best mix of 3-D performance and visual quality. The Matrox Mystique delivered excellent frame rates, which is important to PC game players, but its images were rendered with lower quality.

Beyond pure performance, look closely at the creature comforts a manufacturer offers, such as ease of installation and software utilities that make it intuitive to set screen resolution, color depth, and refresh rate—preferably without making you reboot your machine for the changes to take effect. In this review, the Hawkeye utilities offered with the Number Nine cards deliver the most features. Diamond's InControl tools are also worthy of note, as are the utilities from ATI, Hercules, and Matrox.

Last year the big news was digital video acceleration, offered by boards in addition to standard GUI acceleration. As AVI file formats for content developers begin to fade in favor of the superior



*Of the boards we tested,
the Stealth 3D 2000XL
from Diamond
Multimedia delivered
the best 2-D
acceleration.*

quality of MPEG-encoded files, it becomes more important to have a way to view them. For that you need an MPEG (Motion Picture Experts Group) decoder.

While seven of the boards offer a hardware MPEG decoder as an add-on option (for \$75 to \$350), all come with a software decoding engine. If you're using a fast Pentium (133 MHz or better), a software decoder might be enough to maintain an acceptable frame rate of 15 fps.

A LONG WAY GONE, A LONG WAY TO GO

Mainstream 3-D graphics promises to change the face of our computing environment. Graphics cards that cost less than \$200 retail deliver a usable amount of 3-D acceleration and better 2-D and video performance than the cards they are supplanting. In a few years, the present 2-D user interface will look as dated as block characters on a green-phosphor screen.

Alas, the type of acceleration we want to see across a wide variety of applications—beyond just games—still has some way to go. In terms of speed and visual accuracy, 3-D acceleration will get much better with each new generation of products. Unfortunately for users facing a buying decision today, that next generation is just a couple months away from store shelves. It's still too early to tell who will be the winners in this nascent market and who will fall by the wayside, but the reviews that follow will help you decide which product matches your needs today and can take you into tomorrow.

Appian Graphics

Jeronimo J1

Appian Graphics' Jeronimo J1 (\$230 street for the 4MB version we tested; 2MB version, \$180) is a 2-D-only board with an angle: You can slide two of the relatively inexpensive boards into your PC and display different windows on two monitors. That makes the J1 an interesting option for those putting together a graphics or CAD workstation. If you are a typical mainstream user, however, you can get better 2-D performance along with 3-D capabilities from one of the newer designs reviewed here.

Installation of the J1 is simple, although at times the procedure is at variance with the printed instructions. Still, we had no trouble getting the card up and running. Appian provides a new HydraVision utility (which appears as a tab in the Windows 95 Display Properties window) that lets you set resolution and refresh rate.

The quality of the board's construction is beyond reproach. The J1 employs Cirrus Logic's CL-GD5462 VisualMedia accelerator chip coupled with impressive 500-MBps RAMBus memory support. The J1 was a respectable performer on our new Winstone and WinMark graphics benchmark tests, placing solidly in mid-pack among the 2-D boards—though most of the newer 2-D/3-D designs had a performance edge.

The J1 exhibited no bad habits. It did not leave behind screen artifacts, and it dropped few frames even during full-screen MPEG playback with CompCore Multimedia's SoftPEG software, which is included.

HydraVision's name hints at the multiheaded strength of the J1. You can slide two J1 boards into one PC and put a different window on each monitor. (A single 4MB Jeronimo J2, at \$590, puts the same dual-screen function into one PCI slot.) Add Vibrant Graphics' Soft Engine AutoCAD drivers (\$180) and you'll have a budget workstation. —Winn L. Rosch

Jeronimo J1. List price: 4MB version, \$249. Appian Graphics, Redmond, WA; 800-727-7426, 206-885-0107; www.appiantech.com. Circle 487 on reader service card.

PERFORMANCE TESTS

Graphics Cards



For now, great 2-D and 3-D graphics acceleration doesn't exist on a single board at an irresistible price: You can get fast 2-D performance and passable 3-D, or vice versa. This will change within six months, so for now you'll do best by focusing your purchasing priorities in either the 2-D or the 3-D camp.

What the Numbers Mean

2-D Performance Analysis The best-performing 2-D board in this roundup also includes 3-D features. On this year's Windows 2-D graphics benchmark tests, which include our new ZD Business Winstone 97 and ZD Business Graphics WinMark 97 tests, the overall performance winner was the Diamond Stealth 3D 2000XL. This \$180 board, equipped with 4MB of EDO DRAM, outpaced every other product on our Graphics WinMark tests at both tested resolutions, and it was also at the top on our new Winstone 97 tests, virtually tying the Matrox Millennium, a long-time 2-D performance leader. The Diamond board proved as much as 28 percent faster than the Genoa Phantom 3D and the Spider Tarantula 3D, two of the ten boards we tested that are based on the same S3 ViRGE chip that the Diamond board uses.

The two boards based on the Tseng Labs ET6000—the Jazz G-Force 128 and the VideoLogic GrafixStar 600—produced above-average Graphics WinMark scores, about 10 percent

	RESOLUTION: 24-BIT COLOR		RESOLUTION: 16-BIT COLOR	
	ZD Business Winstone 97 Score	ZD Business Graphics WinMark 97 Score	ZD Business Winstone 97 Score	ZD Business Graphics WinMark 97 Score
2-D ACCELERATORS				
Appien Jeronimo J1	36.3	44.6	36.8	42.1
Hercules Dynamite 128/Video	37.8	50.6	37.8	49.2
IMS TwinTurbo 128P4	35.9 ¹	42.0 ¹	36.9	47.3
Jazz G-Force 128	38.1	51.3	38.1	48.5
Leadtek WinFast S200	32.0 ¹	34.9 ¹	34.8	41.3
Matrox Millennium	39.2	53.6	39.1	51.8
Number Nine Imagine 128 Series 2e	38.3 ¹	52.1 ¹	38.8	54.7
Quadrant Bell Office Choice 6000+	32.7	30.8	34.2	32.0
Spider Lynx 64/V	33.4	33.8	33.8	31.8
STB Lightspeed 128	38.0	50.5	37.9	49.2
VideoLogic GrafixStar 600	38.1	50.6	38.3	48.7
2-D AND 3-D ACCELERATORS				
ATI 3D Xpression+ PC2TV	36.6	45.4	37.1	47.6
Diamond Stealth 3D 2000XL	39.3	57.5	39.0	55.4
ELSA Victory 3D	36.9	47.5	36.9	45.4
Genoa Phantom 3D	36.0	43.1	36.0	40.0
Hercules Terminator 3D	38.2	51.6	38.4	51.6
Intergraph Reactor	36.3 ¹	41.0 ¹	37.6	43.0
Leadtek WinFast 3D S600	38.3	51.4	38.2	50.9
Matrox Mystique	38.9	52.8	38.5	48.2
miroMedia 3D	37.1	46.3	37.3	46.3
Number Nine 9FX Reality 332	36.6	45.4	38.7	43.6
Orchid Fahrenheit Video 3D	36.5	43.8	36.3	N/A*
Spider Tarantula 3D	36.3	43.3	35.7	40.0
	BETTER ►	BETTER ►	BETTER ►	BETTER ►

(1) At 32-bit color depth. N/A*—Not applicable. The product could not perform this test.

HARDWARE

Mainstream Graphics Accelerators

DIRECTDRAW

FULL-SCREEN PLAYBACK

	Animate BltFast		Animate Color Depth (16-Bit)		Video/Action Cinepak Full-Screen Playback ²		Video/Action Indeo Full-Screen Playback ²	
	Millions of pixels per second		Millions of pixels per second		Frames dropped	Maximum frames per second	Frames dropped	Maximum frames per second
Appian Jeronimo J1	133		67		0	39	0	36
ATI 3D Xpression+ PC2TV	94		52		0	93	0	90
Diamond Stealth 3D 2000XL	132		56		0	125	0	57
ELSA Victory 3D	145		69		0	96	0	84
Genoa Phantom 3D	88		38		0	85	0	85
Hercules Dynamite 128/Video	134		71		0	69	0	58
Hercules Terminator 3D	150		68		0	135	0	62
IMS Twin Turbo 128P4	30		25		0	31	3	31
Intergraph Reactor	101		47		N/A*	N/A*	N/A*	N/A*
Jazz G-Force 128	131		79		0	79	0	77
Leadtek WinFast S280	59		N/A*		0	80	0	76
Leadtek WinFast 3D S600	149		71		0	87	0	84
Matrox Millennium	62		34		0	81	0	76
Matrox Mystique	117		62		0	99	0	80
miroMedia 3D	131		63		0	78	0	73
Number Nine Imagine 128 Series 2a	31		24		0	69	0	63
Number Nine 9FX Reality 332	98		45		0	136	0	60
Orchid Fahrenheit Video 3D	89		40		0	85	0	83
Quadrant Bell Office Choice 6000+	45		27		0	70	0	62
Spider Lynx 64/V	N/A*		18		0	73	0	72
Spider Tarantula 3D	88		38		0	85	0	85
STB Lightspeed 128	128		77		0	71	0	63
VideoLogic GraftixStar 600	127		75		0	42	0	38

BETTER ►

BETTER ►

BETTER ►

BETTER ►

(2) Scaled to full-screen from a 160-by-120 pixel resolution. N/A*—Not applicable. The product could not perform this test.

N/A†—Not applicable. This product's performance was too poor to measure.

behind the Diamond board. On the Business Winstone tests, that gap closed to about 2 percent.

One strategy some vendors use is to push the memory clock on the graphics controller beyond the specification set by the chip vendor. For the ViRGE, S3's memory-clock specification is 50 MHz (see the chart "S3 ViRGE-Based Memory Clock Speeds"). Some companies do achieve higher test scores when pushing the memory clock—but not always, and not always without introducing other problems.

For example, if a part is running too fast, a race condition can exist, where not enough time has been allowed for data to reach its destination in a stable, noise-free form, and unwanted artifacts appear on-screen as a result. Worse, a part that runs beyond specifications for a period of time could eventually fail. It is advisable to check into the length of the warranty each company offers. Pairing a fast memory clock with fast high-quality memory gave a few boards in this group an extra edge, but driver optimization still appears to be the best way for a board maker to increase overall performance.

Products that did the best overall on our new WinMark 97 DirectDraw tests—Animate BltFast and Animate Color

Depth—should prove to be good accelerators for video playback and 2-D games. Even Direct3D uses DirectDraw to gain fast access to the screen. The Hercules Terminator 3D performed fastest on the BltFast test. The Leadtek WinFast 3D S600 was close behind.

Our video tests, which scale a postage-stamp-size video window (160 by 120 pixels) up to full-screen, are a good test of the hardware's ability to handle .AVI files. On them, only the Intergraph Reactor dropped video frames.

GDI Bypass: Why Bother? Each year, in this issue, we test each reviewed graphics board under the newest versions of Winstone and WinMark, which make their debut in this story and the roundup of PCs. Advances in the technology used to design the tests make the benchmark programs better each year. See Lab Notes in this issue for a complete description of the new benchmark tests.

GDI bypassing, a controversial optimization technique that boosted 2-D performance on last year's benchmark tests, yields no user benefit this year. In GDI bypassing, a graphics card

continues

PERFORMANCE TESTS

GDI BYPASS

ZD Business Winstone 97[®]GDI bypass
off (score)GDI bypass
on (score)ZD Business Graphics WinMark 97[®]GDI bypass
off (Mpixels/sec)GDI bypass
on (Mpixels/sec)

2-D ACCELERATORS

IMS TwinTurbo 128P4	36.9	37.1	47.3	47.4
Matrox Millennium	39.1	39.2	51.8	52.2
Number Nine Imagine 128 Series 2e	38.8	38.0	54.7	53.6
STB Lightspeed 128	37.9	37.9	49.2	49.6

2-D AND 3-D ACCELERATORS

ATI 3D Xpression+ PC2TV	37.1	37.1	47.6	47.4
Diamond Stealth 3D 2000XL	39.0	38.9	55.4	57.4
Matrox Mystique	38.5	38.6	48.2	49.8
Number Nine 9FX Reality 332	36.7	36.8	43.6	44.0
VideoLogic GrafixStar 600	38.3	38.0	49.7	49.8

(S) 1,024-by-768 resolution, 16-bit color

continued

vendor modifies its driver code so that the code intercepts graphics operations that are normally processed by the Windows GDI (Graphics Device Interface) subsystem. The goal is to intercept a graphics operation (such as drawing text or filling a rectangle) before it is passed to GDI for processing, thus avoiding latencies in the Windows subsystem and boosting performance. Not all operations are bypassed, only a select few that the graphics-board designer feels are important for overall application performance.

Companies that endorse the practice claim the performance boost is seen by end users in real-world applications. Others believe that using GDI-bypassing optimization is simply a way to inflate benchmark test scores artificially. Microsoft is firmly against the practice, declaring that the technique can introduce a compatibility problem and lead to possible system crashes.

On our Winstone 97 and Graphics WinMark 97 tests, we found almost no performance gain when GDI bypassing was enabled (as shown in the chart "GDI Bypass: Why Bother?"). This leads us to conclude that no real-world performance benefit exists to justify the risk of possible compatibility problems.

The Winstone and WinMark results referred to in the reviews and presented on the chart in this section's opening page were logged with GDI bypassing off.

3-D Overview Our new 3-D tests were designed to gauge 3-D video acceleration with several real-world applications, such as VRML browsers and games. We executed all our 3-D tests using Direct3D-compatible graphics board drivers and Direct3D-compliant applications within Microsoft's Direct3D API framework.

If Microsoft Direct3D code detects 3-D hardware upon system initialization, the board's hardware driver is used and the 3-D data is ultimately sent to the Direct3D HAL (hardware abstraction layer) driver software provided by the board vendor. If no 3-D hardware is detected, Direct3D uses its HEL (hardware emulation layer) drivers to render the 3-D frames in software. We performed all our tests with the 3-D hardware enabled.

Many of the results of our 3-D tests only show a 20 to 30 percent performance boost for 3-D hardware acceleration relative to our software-only baseline; we had expected to see a greater boost. One reason is that all our tests required a z-buffer, so an additional performance hit was encountered.

The *z-buffer* holds all the values for depth within the scene. Since only objects that are in front should be drawn to the screen, each of the *z* values has to be read and compared so that the proper sorting can take place. Unlike much more expensive high-end boards that are specifically designed to quickly handle the extra processing of the *z*-compare and read-modify-write operations for each pixel, these mainstream newcomers are not optimized to handle the demands of processing the *z*-buffer. While we expect that most business applications will require a *z*-buffer, most current game developers obviate the need for a *z*-buffer by handling the sorting of elements in the game's code. All the boards we tested would benefit from greater *z*-buffer support.

Overall, the \$200 Intergraph Reactor, with its powerful 3-D feature set, was in a class of its own. We were impressed by its uncompromising ability to render exceptional-looking frames on-screen during every test we threw at it, and by its ability to

S3 ViRGE-Based Memory Clock Speeds

Megahertz		
Diamond Stealth 3D 2000XL	71	
ELSA Victory 3D	72	
Genoa Phantom 3D	50	
Hercules Terminator 3D	78	
Leadtek WinFast 3D S600	75	
miroMedia 3D	70	
Number Nine 9FX Reality 332	50	
Orchid Fahrenheit Video 3D	69	
Spider Tarantula 3D	50	
		Rated speed (50 MHz)

continues

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PERFORMANCE TESTS

		Satellite Rotate ¹		Mars Terrain 3-D World ²			PC Magazine Labs VRML World ³				
		Point sample (frames per second) ▲	Bilinear filtering (frames per second) ▲	Point sample (frames per second) ▲	Bilinear filtering (frames per second) ▲	Bilinear filtering works? ▲	Visual note	Average performance with texture mapping on (frames per second) ▲	Time to render (ms) ▼	Average performance with texture mapping off (frames per second) ▲	Time to render (ms) ▼
▲ Higher scores represent better performance ▼ Lower scores represent better performance.	Chip set										
ATI 3D Xpression+ PC2TV	ATI Rage	22	19	6	5	Yes	Good	9	101	10	88
Diamond Stealth 3D 2000XL	S3 VIRGE	32	27	7	7	Yes	Good	10	88	14	61
ELSA Victory 3D	S3 VIRGE	31	27	6	6	Yes	Good	11	86	14	62
Gigaset Phantom 3D	S3 VIRGE	23	20	5	5	Yes	Good	12	73	9	106
Hercules Terminator 3D	S3 VIRGE	33	28	8	6	Yes	Good	11	83	14	61
Intergraph Reactor	Rendition	27	25	9	9	Yes	Excellent	15	60	16	53
Jazz G-Force 128 ⁴	Tseng Labs	23	23	6	6	—	Peer	9	101	8	126
Leadtek WinFast 3D S800	S3 VIRGE	32	28	7	6	Yes	Good	11	85	14	61
Matrox Mystique	Matrox MGA	28	N/A*	8	N/A*	N/A*	Good	13	70	13	67
miroMedia 3D	S3 VIRGE	23	21	N/A*	N/A*	N/A*	N/A*	9	98	13	70
Number Nine 9FX Reality 332	S3 VIRGE	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
Spider Tarantula 3D	S3 VIRGE	24	20	5	5	Yes	Good	9	104	12	73

(3) 640-by-480 resolution, 16-bit color. (4) Reported for comparison (a 2-D board offering Direct3D acceleration in software only). N/A*—Not applicable: The product could not perform this test.

continued

garner the best overall frames-per-second (fps) scores of any 3-D board.

The ATI 3D Xpression+ also excelled in visual rendering quality, just behind the Intergraph board on a few tests. The Matrox Mystique scored right behind the Intergraph product in frame rate on several 3-D tests, though the board did not deliver some of the visual effects that our developers had put in the scenes (such as fog and alpha blending). We could not run our 3-D tests on Number Nine's 9FX Reality 332, because the company would not supply a Direct3D driver until the Direct3D API is more mature.

One growing controversy surrounding 3-D hardware is whether a board should wait for the vertical blanking interval before moving (or *flipping*) a new frame from the holding buffer to the screen. Microsoft's DirectDraw API says that before executing a page flip to bring the next scene onto the display, the DirectDraw driver must wait until the entire screen is refreshed. But among the boards in this roundup, the Matrox Mystique implements page flips based on the *horizontal* blanking signal. Since the horizontal blanking signal occurs nearly 1,000 times as frequently as its vertical counterpart, the Mystique spends much less time waiting for a chance to flip the new image onto the display.

That translates to a higher overall frame rate for a Direct3D game, but it introduces the possibility of visible incongruities in the screen image (known as *tears*). In some applications, where scenes are changing substantially from frame to frame, causing a relatively low frame rate, the tearing effect is quite noticeable. But in other cases where high frame rates are sustainable, such as games, the tearing may not be noticeable at all.

How We Tested

We tested the graphics accelerators on a 200-MHz Pentium-based Micron Millennia with 32MB of EDO RAM. We used a MAG InnoVision MXP17F (a 17-inch monitor) and an Extron SRI-200 to obtain monitor refresh rates, set at 75 Hz except where otherwise noted.

All tests were performed using Windows 95 with Microsoft Service Pack 1 Update applied. We used each vendor's recommended drivers and installation procedures for our Winstone and WinMark (Business Graphics WinMark) tests. Our base system included Microsoft DirectX 2.0 drivers; vendors' drivers were installed where there were any. We used latest generic S3 Direct3D driver for 3-D tests on ViRGE-based boards and vendor-supplied drivers for all other tests. To test the memory-clock speed of each ViRGE chip, we used a high-speed oscilloscope and frequency counter.

The Satellite Rotate test is a Direct3D application that rotates an object comprising 4,000 triangles rendered with both Gouraud shading and texture mapping. We used Datapath's Realimation STE (space-time editor), a 3-D real-time visualization and manipulation tool, to evaluate each board's rendering quality for features such as fogging, complex texture-filtering modes, alpha blending, perspective correction, and transparency.

Our Mars Terrain 3-D World tests, designed with Sense8's WorldToolKit Test, load the geometry from a 2.9MB VRML file comprising 14,022 polygons of two types. The terrain consists of triangles. Perspective correction of the texture maps is used for all tests.

The PC Magazine Labs VRML World tests were modeled in Radiance Ez3d VRML Author Pro VRML 1.0 and assembled and optimized with Integrated Data Systems' V-Realm Builder. The images are based on actual blueprints of PC Magazine Labs. They involve a 360K primary VRML file, a 24K VRML in-line file for the monitor, and four JPEG-format texture files.

For these tests WIRL, a Direct3D retain-mode VRML browser from VREAM, was augmented with a frame counter. Using VREAM's VRML extensions, we established a cyclical path through the model Labs to provide consistency from run to run. We test performance with textures and without.—*Analysis written by Jeff Mace.*

Special thanks to Gregg Whitfield and Brett Butcher of Datapath, Debbie Nelson and Kenneth Pimentel of Sense8, John Fairley of Vream, and to David Nadeau of the San Diego Supercomputer Center, for their help in developing these tests.

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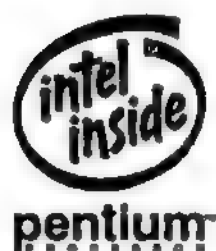
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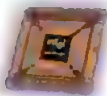


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ATI Technologies Inc.

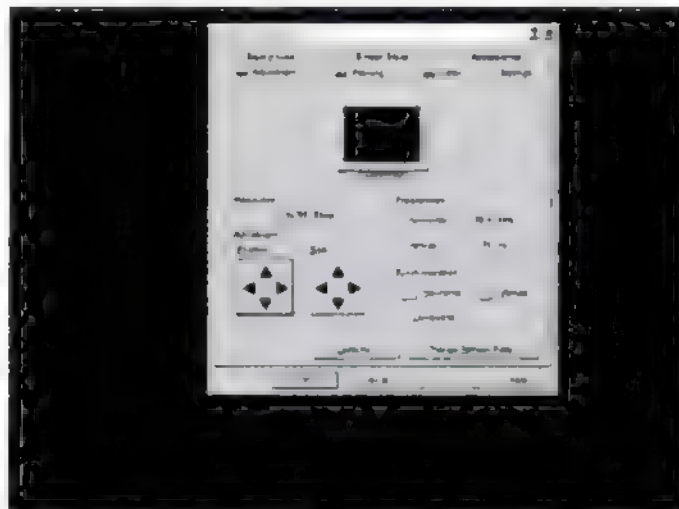
3D Xpression+ PC2TV

Combining reasonable 2-D performance, top-quality video playback, an excellent 3-D feature set, and some nice extras, ATI Technologies' 3D Xpression+ PC2TV (4MB version, \$200 street) stands up as a solid general-purpose accelerator that should be on your short list.

An improved version of ATI's short-lived 3D Xpression, the RageII-based Xpression+ adds support for a 16-bit hardware z-buffer and an impressive list of Direct3D features, including support for 4-bit and 8-bit compressed textures, bilinear and trilinear filtering, MIP mapping, alpha-blended transparency, and fog. The board's DirectX II display driver was among the first to receive Microsoft certification; its relative stability and maturity was reflected in our Direct3D testing. The card correctly implemented every 3-D feature we threw at it, which placed it in a distinctly small minority among the boards in this roundup.

With an improved 170-MHz DAC and

fast SDRAM, the Xpression+ can refresh your screen at rates high enough to outstrip all but the most advanced monitors, and the card correctly recognized our DDC-2 compatible Plug and Play monitor and configured itself appropriately. ATI's driver set features well-implemented Win-



The intuitive interface on ATI's display utility makes it easy to change settings.

dows 95 utilities and support for multiple operating systems and 3-D API sets, including advanced support for OpenGL under Windows NT. Its setup procedure under Windows 95, however, was a bit confusing. ATI instructs you to install Di-

rectX II before you install the Xpression+'s drivers, but Windows 95 finds the Xpression+ hardware in its Plug and Play boot sequence and prompts you to install the drivers before you've had a chance to load DirectX. ATI says it will have fixed the problem by the time you read this.

ATI has upped the features ante in the mainstream market by offering direct-to-TV capabilities on the Xpression+. You can use it to display a computer image on any NTSC or PAL TV monitor, for presentations and training in the office or for games and multimedia at home. This is a first for this category; expect other board makers to follow suit. The picture quality is quite acceptable, rivaling that of \$200 scan converters we've seen.

The Xpression+ finished squarely in the middle of the pack on our WinMark 97, Winstone 97, and DirectDraw tests—roughly 30 percent slower than the top scorer, Diamond's Stealth 3D 2000XL. While its visual quality under Direct3D was good, performance was again lackluster. The Xpression+ was significantly slower than this roundup's top performer,

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Intergraph's Reactor, on every test.

ATI bundles a nice collection of Rage II-specific 3-D games with the card and includes customized software support for MPEG playback via its ATI Video Player. The 3D Xpression+ is no performance screamer, but its strong 2-D and 3-D functionality and its unique TV-out capability make it a card to consider. —Jon Hill

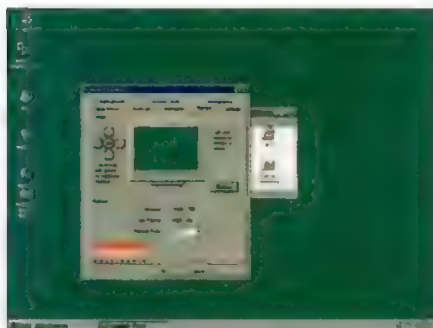
3D Xpression+ PC2TV. List price: 2MB version, \$199. ATI Technologies Inc., Thornhill, Ontario, Canada; 905-882-2600; www.atitech.ca. Circle 488 on reader service card.

Diamond Multimedia Systems Inc.

Stealth 3D 2000XL



Diamond Multimedia Systems' Stealth 3D 2000XL (\$180 street for the 4MB version we tested; 2MB version, \$150) is a ViRGE-based board that offers the carefully worded claim of "outrageously fast graphics—plus 3-D!" The Stealth does indeed deliver top 2-D graphics performance, which alone makes



Diamond's InControl Tools 95 gives quick access to a host of features.

it the best choice among the graphics boards reviewed here. Its average 3-D acceleration may disappoint those who assume the "plus 3-D" part will also be of the "outrageously fast" variety, but the Stealth's combination of attributes make it worthy to be an Editors' Choice.

Diamond's InControl Tools 95 is outstanding and well-integrated into the Windows 95 environment. It adds panels to the Display Properties dialog box and customizes the desktop's right-click context menu, making it a snap to change

screen resolution, refresh rate, GDI acceleration settings, zoom, and desktop and viewport settings. You can change color depth and resolution on the fly without rebooting your system, a handy feature when you switch to 8- or 16-bit color games and multimedia applications. You can have a virtual desktop larger than your screen's resolution and move around it by moving the mouse pointer to the edge of the screen. HTML-based help information is provided on the CD, and a wizard walks you through initial configuration of the Display Properties dialog.

The Stealth aced the WinMark and Winstone tests. Its performance on the DirectDraw tests varied, but overall it turned in respectable performance. Likewise, it was an average performer overall on our 3-D test suite and delivered the good (though not excellent) visual quality we saw from all the ViRGE designs.

The included MPEG Arcade player from Mediomatics performed reasonably well, with good visual quality. Diamond includes two 3-D games and Compton's Interactive Encyclopedia 1996.



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As a general-purpose business and home graphics board with respectable 3-D functionality, Diamond's Stealth 3D 2000XL is an excellent choice and a great value. It deserves to be at the top of your shopping list.—*Rob Glidden*

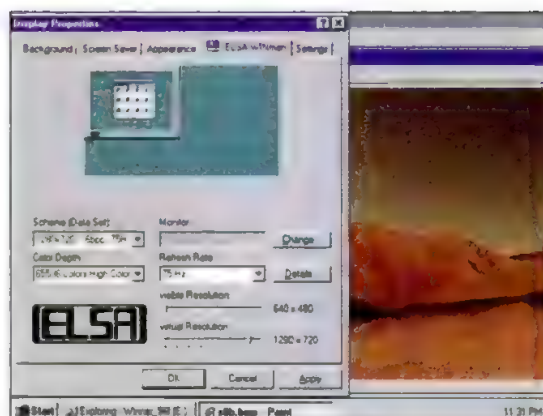
Stealth 3D 2000XL. List price: \$200. Diamond Multimedia Systems Inc., San Jose, CA; 800-468-5846, 408-325-7000; www.diamondmm.com. Circle 489 on reader service card.

ELSA Inc.

Victory 3D

The Victory 3D (\$280 street for the 4MB version we tested) from ELSA is a middle-of-the-pack 2-D performer that exhibits moderate but usable acceleration of 3-D content. With its wide array of drivers and graphics-oriented features, this ViRGE-based board may fit the needs of some CAD and graphics users; mainstream business users can find a more suitable and less expensive ViRGE-based offering elsewhere.

Installing the Victory was straightforward,



ELSA's WINman applet lets you set up a virtual workspace that extends beyond your screen.

ward, whether we chose ELSA's automated procedure or Windows 95's automatic hardware detection. ELSA's WINman applets provide extra functionality, including on-the-fly mode switching, monitor refresh-rate controls, and a virtual workspace extending beyond your screen.

You can also set and save nonstandard resolutions, which can be handy for desk-

top publishing and other graphics work. ELSA offers a wider range of drivers than most, including ones for Windows NT, AutoCAD, and Microstation.

On our WinMark and Winstone benchmark tests, the Victory was distinctly average, posting scores nearly identical to the mean performance of all boards tested in this roundup. It performed better on our DirectDraw test suite, where it placed fourth overall.

The Victory was one of the best-performing ViRGE-based products on our 3-D tests,

which indicates ELSA has done a good job of tweaking the most out of the chip. Simple, nontextured acceleration chores showed an impressive 60 percent frame-rate improvement over software-only Direct3D performance. As with other ViRGE designs, though, enabling complex features such as bilinear filtering slowed the board considerably. Its 3-D image quality was good, though not as ap-

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pealing as the class leader, Intergraph's Reactor.

You can get better 2-D and 3-D performance for less money. Users who need the driver support, nonstandard resolutions, and 3-D acceleration should take a look.—*Linda and Erick Von Schwebber*
Victory 3D. List price: \$329. ELSA Inc., San Jose, CA; 800-272-3572, 408-935-0350; www.elsa.com. *Circle 490 on reader service card.*

Genoa Systems Corp.

Phantom 3D

Like ghost sightings that defy scientific observation, this Phantom's performance seemed to vanish into thin air. Genoa Systems' Phantom 3D (\$240 street for the 4MB version we tested) is priced higher than our Editors' Choice, Diamond's Stealth 3D 2000XL, and it delivers considerably less performance.

The Plug and Play-compliant Phantom was easy to install, thanks to Windows 95's automatic hardware detection. It was also well-behaved, with no notice-

able screen artifacts. But the ViRGE-based board scored consistently below average on all our WinMark and Winstone tests at all resolutions and color depths. Its DirectDraw performance was uniformly at the bottom of the barrel—not good for game players, an audience Genoa intends to serve with this card.

Don't look here for blistering 3-D performance either: The Phantom posted the lowest scores on several 3-D tests. Removing the textures upped the board's performance only to second from last on those tests. The Phantom's 3-D images looked good, with just the minor incongruities we saw from all the ViRGE boards.

Genoa expects to be shipping a new ViRGE VX-based, VRAM-powered Phantom board by the time you read this. We would wait for that newer, more powerful model before giving this ghost a chance.—*LVS and EVS*

Phantom 3D. List price: 4MB version, \$269. Genoa Systems Corp., San Jose, CA; 408-362-2900; www.genoasys.com. *Circle 491 on reader service card.*

Hercules Computer Technology Inc.

Dynamite 128/Video, Terminator 3D

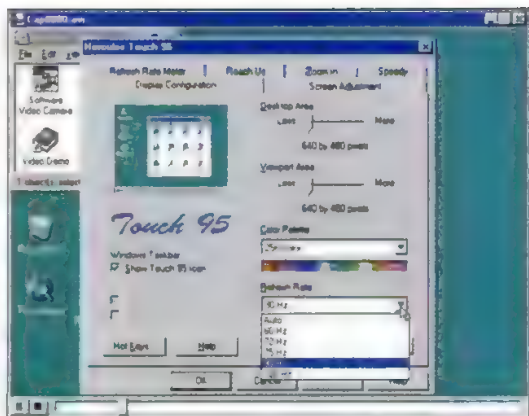
Hercules Computer Technology's two entries, the 2-D-only Dynamite 128/Video (\$140 street for the 4MB version we tested) and 3-D-capable Terminator 3D (4MB version, \$199 list) are above average in performance, software amenities, and affordability. The Dynamite is a solid though not exceptional choice for most general applications. The Terminator was in the top tier in most of our 3-D benchmark testing and is an excellent board for game players who are working through dozens of games that now support S3's ViRGE chip set.

Installation of both boards is straightforward. Both boards ship with Xing's software MPEG drivers and Touch 95, Hercules's user-friendly graphics control utilities, which are a cut above those delivered by other boards in this price range. All key resolution, color depth, and virtual window controls (with pan lock and automatic centering) are conveniently



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Hercules's Touch 95 utilities are a cut above what others in this range offer.

located on Touch 95's front panel. Touch 95 offers on-the-fly refresh-rate and resolution adjustment, but to change color depth you have to reboot your PC.

Hercules clearly has invested significant resources in tuning its chip sets for maximum performance. On our Winstone and WinMark tests, the Dynamite placed higher than most other ET6000-based 2-D boards and performed better

than average overall.

The Terminator's fast single-cycle EDO DRAM helped it place near the head of the pack overall on our WinMark tests, and it was second among ViRGE-based boards. Results on our Winstone tests were similarly commendable. The board was unmatched on our DirectDraw tests, and that helped it place near the top on some of our 3-D measures as well.

Overall, both boards can run with the fast crowd, and both are clearly more than adequate for general business use and game playing. Hercules's useful software and generous five-year warranty and toll-free customer support should put these affordable entries near the top of your list.—JO

Dynamite/128 Video. List price: 4MB version, \$159. **Terminator 3D.** List price: 4MB version, \$199. Hercules Computer Technology Inc., Fremont, CA; 800-532-0600, 510-623-6030; www.hercules.com. Circle 492 on reader service card.

Integrated Micro Solutions

TwinTurbo 128P4

An experienced player in the Macintosh market, Integrated Micro Solutions enters the PC graphics-board fray with its 2-D-only TwinTurbo 128P4 (\$300 street for the 4MB version we tested). The board comes with a competent set of software amenities and can comfortably support higher resolutions than other boards in this roundup. But low benchmark test results may lead you to pass on this first-generation product.

The TwinTurbo is based on IMS's own 128-bit 2-D accelerator chip and is equipped with 4MB of VRAM, producing a maximum video configuration of 1,600-by-1,200 resolution and 16-bit color depth at a refresh rate of 75 Hz—more than sufficient for 17-inch and larger monitors. The board ships with drivers for AutoCAD Release 12 and Release 13. Windows control and Mediomatics' software MPEG player round out the bundle.

Windows 95 recognized the TwinTurbo immediately. The control utilities

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Mainstream Graphics Accelerators

load as an integrated subset of the Windows Display Drivers dialog box and supply all the basics—including pan and zoom, screen centering, and on-the-fly refresh rate and resolution adjustment—plus color management, a nice extra in this class.

Hardware performance proved the TwinTurbo's downfall. The board placed well behind most on our WinMark tests. Scores on Winstone tests were more favorable, but the TwinTurbo still could not outpace the much less expensive ET6000-based boards in three out of four benchmark tests, and it placed well behind the equivalently priced Imagine 128 Series 2e from Number Nine Visual Technology.

The IMS TwinTurbo could be a diamond in the rough if you're seeking an inexpensive card for high refresh rates on bigger monitors. Business users who never work above 1,024-by-768 resolution can find a less expensive solution.—*JO*
TwinTurbo 128P4. List price: 4MB version, \$399. Integrated Micro Solutions, San Jose, CA; 888-467-8282, 408-369-8282; www.integratedmicro.com. Circle 493 on reader service card.

Intergraph Computer Systems

Reactor



The Reactor (\$180 street for the 4MB version we tested), from Intergraph Computer Systems, is a 3-D chain reaction in the making. While not a standout in 2-D performance, this Verite-based board was the indisputable leader on our 3-D performance testing in both acceleration and image quality.

After the easy installation (the driver adds a tab to the Windows 95 Display Properties box, where you can adjust refresh rate, color depth, and 3-D rendering defaults), we were cruising through smooth-shaded VRML worlds at more than 15 fps, nearly double the rate of 3-D with software emulation. Texture mapping and bilinear filtering lowered the Reactor's performance by only the slimmest margin, in contrast with other 3-D cards.

The Reactor's bilinear filtering was simply gorgeous—the best we have seen on any 3-D accelerator at any price. The

filtering effectively removed all the jaggies associated with low-resolution texture maps, with no discernable impact on performance. Direct3D immediate-mode applications deliver alpha-blended transparency and realistic fog on the Reactor with similar quality, also with no significant performance hit.

The tradeoff is in the Reactor's 2-D performance. The board placed just above average on our Winstone tests, while scoring below average on our WinMark graphics benchmark tests. On DirectDraw tests, it was in the middle of the pack.

The Reactor also stumbled in video playback performance. It was the only board in this roundup to drop frames (and a significant number, at that) when we scaled video clips to full-screen. Intergraph says the next driver releases will have better 2-D performance; this initial release focused on 3-D.—*LVS and EVS*
Reactor. List price: 4MB version, \$199. Intergraph Computer Systems, Huntsville, AL; 800-692-8069, 205-730-5441; www.intergraph.com. Circle 494 on reader service card.

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Jazz Multimedia Inc.

G-Force 128

Jazz Multimedia's G-Force 128 (\$170 street for the 2MB version we tested) delivers excellent 2-D graphics performance and nicely scaled video playback. Other 2-D-only ET6000-based boards are now available with 4MB of memory for just a few dollars more; if you can find the G-Force at a bargain, though, its performance will not disappoint.

Installing the card under Windows 95 was a fairly painless affair, but the G-Force had problems with our DDC-2 Plug and Play monitor. At a resolution of 1,024 by 768, it defaulted to an interlaced refresh rate of 87 Hz—far below our test monitor's and the G-Force's capabilities. We had to lie to Windows 95 and tell it that we were using a non-Plug and Play monitor to get an acceptable refresh rate, and even then the card defaulted to the lowest rate. Fortunately, changing the refresh rate is a simple affair via the folder tab the G-Force's driver places in Windows 95's Display Properties dialog. Jazz

says it is aware of the Plug and Play refresh-rate problem and promises to have fixed it by the time you read this. The G-Force's ViewManager display utility lets you associate applications with a particular resolution and color-depth combination and switch among them on the fly.

The G-Force is particularly adept at video playback and supports multiple simultaneous video windows, a useful feature for video conferencing. In theory, the card's multibank MDRAM should be particularly adept at servicing multiple concurrent streams (for example, video and 2-D graphics), though you'll probably need the 4MB version (\$249) for this to be practical.

On our 2-D graphics testing, the G-Force more than held its own, finishing among the top quarter on the Winstone and WinMark tests. It also performed well on our DirectDraw tests, which promises good game performance.

Once the Plug and Play install kink is ironed out, business and home PC users on a budget should be satisfied by the G-Force's top-notch video playback and re-

spectable 2-D performance.—JH

G-Force 128. List price: 2MB version, \$199. Jazz Multimedia Inc., Santa Clara, CA; 888-367-5200, 408-727-8900; www.jazzmm.com. Circle 495 on reader service card.

Leadtek Research Inc.

**WinFast S280,
WinFast 3D S600**

The two Leadtek Research accelerators we review present a study in contrasts. The WinFast 3D S600 (\$190 street for the 4MB version we tested) is above average across the board, but the 2-D-only WinFast S280 (2MB version, \$110 street) is an underachiever.

Based on S3's Trio 64V+ chip, the WinFast S280 required more than an hour of trial and error to set up and configure properly. Once running, it placed at or near the bottom on every 2-D performance measure.

On the other hand, we easily installed the ViRGE-based S600, and everything went according to the directions. The S600 scored in the top tier on our Win-

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stone and WinMark benchmark tests. It placed second overall (behind Hercules's Terminator 3D) on our DirectDraw tests, which indicates that Leadtek has done a commendable job optimizing the DirectDraw drivers and bodes well for game players.

The S600 did fairly well on our 3-D tests, allowing us to navigate a smooth-shaded VRML world at more than 14 frames per second. As is common with other ViRGE designs, however, turning on texture mapping and bilinear filtering dropped the frame rate noticeably, to about 10 fps. Texture mapping made the S600's performance erratic: We saw the frame rate climb and dip more with textures than without. The quality of filtering and fog with Direct3D immediate-mode applications was good.

Even with its low price, the WinFast S280 is tough to recommend. The WinFast S600 is a competent business graphics workhorse that also delivers acceptable 3-D acceleration.—*LVS and EVS*
WinFast S280. List price: 2MB version, \$109.
WinFast 3D S600. List price: 4MB version,

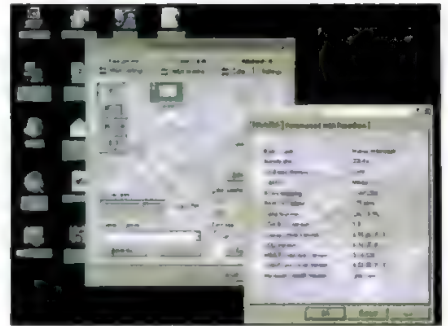
\$199. Leadtek Research Inc., Fremont, CA; 510-490-8076; www.leadtek.com. Circle 496 on reader service card.

Matrox Graphics Inc.

Matrox Millennium, Matrox Mystique

Matrox's entries in this roundup are two very different products. The Millennium (\$270 street for the 4MB version we tested) is a top-flight 2-D accelerator for business and graphics users that also offers some 3-D features. The Mystique (4MB version, \$230 street) is a 3-D-capable board meant for both business users and game players, and it hits the mark nicely.

The cards share a number of important characteristics, including solid 2-D performance, aggressive pricing, and a full range of add-in daughterboards. Both cards are easily installed with Matrox's excellent PowerDesk utility set. Both correctly recognized our Plug and Play monitor and negotiated acceptable refresh rates (75 Hz and higher) at every resolu-



Matrox's excellent PowerDesk utility set makes changing display properties a snap.

tion. Each card also has its own line of daughterboard-based upgrades that range from hardware MPEG decoders to video capture cards to TV tuners.

The Matrox Millennium has been around for more than two years now (it was Editors' Choice in our issue of June 25, 1996), and as benchmark test results clearly show, the card has remarkable staying power. The MGA 2064W-based Millennium can be configured with up to 8MB of fast WRAM; when combined with the company's superfast 220-MHz RAM-

Multimedia monitor has built-in speakers and microphone, saving valuable desktop space.

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atures a design that not only saves space, it makes working and playing easier than ever.

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ers can get better performance and more user-friendly utilities elsewhere.

Rather than modifying the Display Properties dialog, a standard and convenient approach that other graphics boards use for software configuration, the miroMedia control utility creates a new toolbar on your Windows 95 desktop. Changing color depth requires rebooting your system. Changing refresh rate is awkward and nonintuitive, requiring you to change monitor type by selecting a miro monitor from an .INF file instead of your own.

Heavy desktop publishing users may find a use for the 1,408-by-1,024 resolution mode, which lets you see a whole page on the screen at one time. Another handy feature is the Magnify window, which displays a magnified version of the screen region around your mouse pointer. The software also lets you adjust the color tint of your monitor.

On our Winstone and WinMark tests, the miroMedia performed almost exactly in the middle of all boards tested. It performed slightly above average on the DirectDraw tests. MPEG playback with the

Xing Technology player was very good, with good scaling and no visible artifacts at full screen. On the 3-D tests, however, the miroMedia performed relatively poorly. It failed several tests altogether, and scored in the bottom third on the VRML tests. In its favor, the card's showing on the Satellite Rotate test, where DirectDraw performance figures heavily, was good.

If you are looking for 3-D performance, you can do better. If you do a lot of desktop publishing, you may want to consider the miroMedia 3D.—*JO*
miroMedia 3D. List price: \$199. miro Computer Products Inc., Palo Alto, CA; 800-474-6476, 415-855-0955; www.miro.com. Circle 498 on reader service card.

Number Nine Visual Technology

Imagine 128 Series 2e, 9FX Reality 332

Based on its own Imagine 128 controller, Number Nine Visual Technology's 2-D-only Imagine 128 Series 2e (\$330 street for the 4MB version we tested) provides fine graphics acceler-

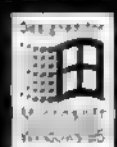
ation and outstanding control utilities. The ViRGE-based, 3-D-capable 9FX Reality 332 (\$180 street for the 2MB version we tested) produced somewhat lackluster performance overall; while the same control utilities add value, users seeking a hot 3-D game platform or even a moderately priced business graphics card can probably do better elsewhere.

Number Nine's HawkEye display utilities, available for Windows 3.x and Windows 95, are well-considered and flawlessly implemented. HawkEye features include a virtual desktop with pan lock and automatic centering, up to 8X zoom, and on-the-fly refresh rate and resolution adjustment. The utilities go the competition several better, with virtual screen and hotkey combinations that let you easily run applications side by side in their own 640-by-480 windows. Two information screens—one showing driver and hardware configuration, the other technical support information—are also nice touches. Number Nine has even included color-correction capabilities. Although some boards may outmuscle the Number Nines,



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DAC, the card delivers excellent performance and usability in true-color modes to a resolution of 1,600 by 1,200. The 4MB model we tested is at or near the top of every 2-D graphics performance category.

The Millennium begins to falter, however, under the more exotic demands of video playback, DirectDraw 2-D animation, and Direct3D animation. Its video engine can pump frames out at a decent pace but provides interpolated scaling in only one direction, so visual quality is poorer than most of its rivals. Our DirectDraw 2-D testing left the Millennium in the bottom half of the pack, and the card's 3-D capabilities do not include texture mapping—standard fare on a mainstream Direct3D accelerator—which makes it ill suited for games. Its ability to implement Gouraud shading via hardware is useful for CAD-based 3-D rendering, though, and the company still ships some of the best AutoCAD drivers in the business.

The new Mystique sets its sights squarely on Direct3D. Its MGA-1064SG chip is an advanced bus-mastering controller with support for perspective-corrected texture

maps, high-resolution palletized textures, texture transparency, and tile-based MIP mapping. But it lacks hardware support for a number of features—bilinear filtering for texture maps, true alpha blending, and fog—found in other 3-D implementations. As a result, Direct3D applications that have these features are visibly improved when displayed on a card that supports these effects in hardware.

Matrox says it sacrificed some effects for a higher frame rate, which might be an acceptable tradeoff for fast-paced game action. Indeed, on our 3-D tests, the Mystique spits out Direct3D frames faster than most of its competitors. The subjective game-playing experience—taking into account frame rate—place the Mystique second only to Intergraph's Reactor in this roundup.

In the 2-D arena, the Mystique was a consistent performer, placing in the top ten of tested boards on our WinMark and Winstone tests. And its video playback quality (for both .AVI and MPEG) is much improved over the Millennium's, incorporating both *x* and *y* interpolation.

These are stable, intelligently designed products that stack up well against their current competition. The mature Millennium can deliver the big-screen 2-D performance business and graphics users need. The Mystique couples respectable 2-D acceleration for business applications with good—if not religiously rendered—3-D visuals for game players.—JH

Matrox Millennium. List price: 4MB version, \$299. **Matrox Mystique.** List price: 4MB version, \$259. Matrox Graphics Inc., Dorval, Quebec, Canada; 514-685-2630, www.matrox.com. Circle 497 on reader service card.

miro Computer Products Inc.

miroMedia 3D

The miroMedia 3D (\$190 street for the 2MB version we tested), from miro Computer Products, is an adequate 2-D but a disappointing 3-D accelerator. Desktop publishers may be intrigued by its ability to show a full layout on-screen in the special resolution mode it offers, but general business users and game play-



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Mainstream Graphics Accelerators

none can compete in terms of luxury.

The business-oriented Imagine ships with drivers for Windows NT 3.51 and 4.0, both with OpenGL support and AutoCAD, Microstation and 3D Studio drivers. The chip supports some 3-D features useful to CAD/CAE users, such as dynamic flat shading and Gouraud shading. Users of 17-inch and larger displays should note that a comfortable refresh rate at 1,024-by-768 resolution means dropping to 16-bit color depth, as the board can deliver only 63 Hz at this resolution in 24-bit color.

The Imagine proved a stalwart performer on our Winstone and WinMark tests, reinforcing its usefulness as a business-application accelerator. Its Direct-Draw results, however, generally trailed the pack, so game players may want to look elsewhere.

In addition to the HawkEye utilities, the Reality includes three 3-D games plus Asymetrix's Web3D, a tool for creating 3-D graphics and animations on the Internet. The board produced good results on our 2-D benchmark tests, but we could not get official test results for most of our 3-D test suite: The board would not work on our tests with S3's generic driver.

Most corporate users will find the Imagine 128 Series 2e a good combination of fast hardware and useful software. While the 9FX Reality 332 is a reasonable 2-D performer, its 3-D acceleration is still a question mark.—JO

9FX Reality 332. List price: 2MB version, \$159. **Imagine 128 Series 2e.** List price: 4MB version, \$349. Number Nine Visual Tech-

nology, Lexington, MA; 800-438-6463, 617-674-0009; www.nine.com. *Circle 499 on reader service card.*

Orchid Technology

Fahrenheit Video 3D

In the ebbs and flows of testing cycles and product rollouts, this was a bad year for Orchid Technology's Fahrenheit Video 3D (\$170 street for the 2MB version we reviewed). The product crashed on several benchmark tests and performed poorly in those it completed, especially when compared with other ViRGE-based boards. Orchid's software utilities are relatively modest, and the board is priced higher than many faster cards. Overall, the Fahrenheit is tough to recommend.

Equipped with 2MB of EDO DRAM, the Fahrenheit pushes a refresh rate of 85 Hz at 1,024-by-768 resolution in 16-bit color mode—more than sufficient for comfortable big-screen viewing. The board ships with a commendable array of drivers, including those for AutoCAD, Microstation, OS/2 Warp, and Windows NT. Orchid also bundles three 3-D games and Xing Technology's XingMPEG Player with the card.

Installing the card is easy (all drivers and utilities are on CD-ROM), but Orchid's display utilities are fairly primitive. For example, the virtual desktop has no auto-centering or preview mechanism, which limits its utility. While you can adjust the cursor color, there is no overall color-correction function, hotkey support, or zoom control. What there is works well, but most competing boards offer more.

The Fahrenheit could complete neither our new 1,024-by-768 WinMark and Winstone benchmark tests nor our 3-D test suite on our Micron P200 test-bed computers. The board did complete those tests on other computers, so the problem isn't pervasive. Still, we have to forego printing any performance results because they are not comparable across test-beds.

The results of those tests that Fahrenheit did complete weren't encour-

aging. The board ranked in the bottom half on 800-by-600 resolution WinMark and Winstone tests, with a half-dozen ViRGE-based boards showing better performance.

Considering the meager software offerings and the compatibility problems we experienced, those seeking a graphics card for game playing or general use should probably look elsewhere at this point.—JO

Fahrenheit Video 3D. List price: 2MB version, \$199. Orchid Technology, Fremont, CA; 800-577-0977, 510-651-0230; www.orchid.com. *Circle 500 on reader service card.*

Quadrant Components Inc.

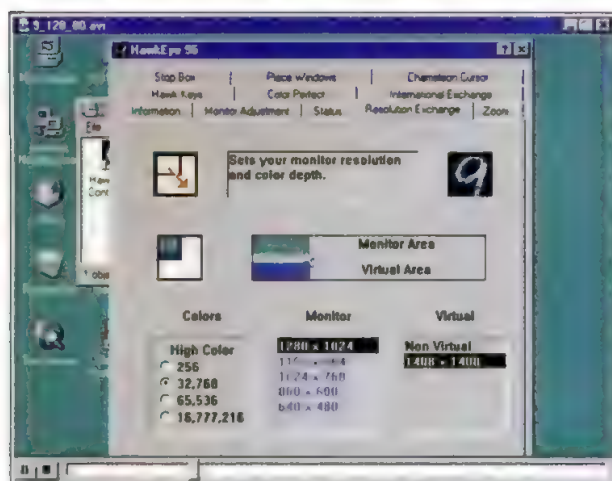
Bell Office Choice 6000+

Old age races through the graphics industry like a nitrogen-fueled bulldozer. Its ravages are no better demonstrated than by the eight-month-old Bell Office Choice 6000+ (\$220 street for the 4MB version we tested), marketed by Quadrant Components, Northwestern Bell's U.S. distributor for computer products. What would have been a killer combination two years ago—a top-of-the-line accelerator massed with fast VRAM chips—now drags along as second-slowest in PC Labs' tests. Quadrant plans to have a new ViRGE-based board, the Office Choice 3-D, available by the time you read this.

The centerpiece of the Office Choice is S3's Vision 968 accelerator, a competent but aging 64-bit engine. Quadrant couples it with 70-ns VRAM and a host of support components that make a big board—4.5 by 9 inches. In fact, the board may be too tall or too long to fit some PCI slots (a PCI short card measures 4.2 by 6.8 inches).

Setup is standard Windows 95: Slide in the board, boot up, and insert the driver disk into your drive, or use Windows 95's supplied driver. We didn't detect a difference between Quadrant's driver and Windows 95's Vision968 mini-driver. We had difficulty setting a refresh rate other than 85 Hz, until Quadrant supplied a display-refresh property sheet written and labeled by S3. The Office Choice comes with only a rudimentary manual, minimal drivers, and MPEG software (XingMPEG).

As a 2-D graphics board, the Office Choice 6000+ worked well, without bad habits or screen artifacts. It simply has lost the race with old age—and with its competition.—WLR



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Bell Office Choice 6000+. List price: 4MB version, \$229.95. Quadrant Components Inc., Fremont, CA; 510-656-9988; www.quadrantinc.com. *Circle 501 on reader service card.*

Spider Graphics Inc.

Lynx 64/V, Tarantula 3D

The Lynx 64/V and Tarantula 3D from Spider Graphics are the least expensive graphics boards in their respective classes in this roundup, and our testing experiences show that corners must have been cut somewhere. The 2-D Lynx 64/V (with 2MB of DRAM, \$55 street) offers a difficult installation and unacceptable performance. Don't be tempted by the low price. The 3-D-capable Tarantula (with 4MB EDO DRAM, \$140 street) is a more solid offering, but it is bested by the other ViRGE-based designs we saw.

The Lynx is shaky at best. Making sense of the not-quite-English manual is maddening. The Spider Web software control is rudimentary but straightforward; you can switch resolutions, refresh rates, color depths, and virtual screen size.

The Lynx's on-screen performance was poor. It exhibited artifacts, sometimes leaving shadows behind as we moved windows. Although the chip the board is based on—an IGA1682—is classed as a 128/64-bit accelerator by its maker, Intergraphics Systems, the Lynx dawdles in drawing and falls apart playing video. Using Mediomatics' MPEG Arcade software, which is included, it could not handle full-screen playback and dropped many frames. We saw playback artifacts even at the smallest image sizes.

The ViRGE-equipped Tarantula 3D substantially improves on the Lynx's on-screen behavior, and the software adds greater consistency, new icons, and better control. There were no noticeable artifacts, and MPEG playback was fine. Like other ViRGE-based boards, the Tarantula's 3-D renderings were good. It generally languished among the slowest 3-D boards, though its performance was acceptable given its price point.

Budget-minded users who want 3-D capabilities at a low price should consider the Tarantula. The cut-rate Lynx 64/V asks for too many compromises.—WLR
Lynx 64/V. List price: 2MB version, \$65.



***STB's Lightspeed 128
delivers good GUI and
video acceleration for
users on a budget.***

Tarantula 3D. List price: 4MB version, \$145. Spider Graphics Inc., San Jose, CA; 408-526-0535; www.spdi.com. *Circle 502 on reader service card.*

STB Systems Inc.

Lightspeed 128

The Lightspeed 128 (\$170 street for the 2.25MB version we tested), from STB Systems, is a 2-D-only board that delivers good GUI and video acceleration for business users on a budget.

Installing the Lightspeed was easy, though the card did not automatically recognize our Plug and Play monitor: We had to select from the list in the settings box. The card did properly assign a default vertical refresh rate in excess of 75 Hz, though. The Lightspeed comes with Mediomatics' MPEG playback software and STB's own Vision 95 utility, which lets you conveniently swap virtual and desktop resolutions (but not color depths) on the fly without rebooting Windows 95 or even toggling to the Display Properties dialog box.

As with all of the ET6000-based products, the Lightspeed 128 boasts a top-quality video playback engine and impressive 2-D graphics performance. The card's multibank MDRAM is especially suited to servicing several concurrent data streams, and the extra 256K of memory in STB's implementation gives it an edge over similar 2MB products at little or no upcharge. Potential buyers should note, however, that the board cannot be upgraded to 4MB should your resolution and color-depth needs increase down the road.

The Lightspeed sped through our WinMark 97 and Winstone 97 tests, fin-

ishing right on the tails of the fastest boards in the review and roughly on a par with the other ET6000-based products. DirectDraw results were also encouraging (although boards configured with 4MB of memory had an advantage here).

Budget-conscious users will be pleased with the Lightspeed's fine 2-D graphics performance, and the card is well suited for videocentric applications. Given comparable costs, the 2.25MB Lightspeed 128 gets the nod over 2MB ET6000 implementations. Those who think they'll need the flexibility of a 4MB design should look elsewhere.—JH

Lightspeed 128. List price: 2.25MB version, \$189. STB Systems Inc., Richardson TX; 888-234-8750, 214-234-8750; www.stb.com. *Circle 503 on reader service card.*

VideoLogic Inc.

GrafixStar 600

The GrafixStar 600 (\$160 street for the 2MB version we tested) is a 2-D-only board that delivers better-than-average graphics performance for general business applications. Its attractive price and upgrade path to 4MB make it a good choice, though video-intensive users should be wary of its below-par MPEG playback.

The ET-6000-based GrafixStar includes SmartTools, a Microsoft Office-like icon bar that lets you easily configure various graphics-related settings. With SmartTools, you can zoom in and out, customize hotkeys, change screen resolution and refresh rate, and add your own program icons. But to change color depth you have to reboot your system, which can be a nuisance.

The GrafixStar was a respectable performer on our 2-D benchmark tests. It scored in the top quarter on most Winstone and WinMark measures. It also did better than average on our DirectDraw suite, which is a good sign for game players. The GrafixStar was very weak at MPEG playback, however: Video scaled to full-screen (1,024-by-768 resolution) slowed to 1 frame per second. Playback of .AVI files was fine.

If all you need is 2-D acceleration for business apps and games, the GrafixStar 600 is worth considering.—RG □

GrafixStar 600. List price: 2MB version, \$169. VideoLogic Inc., San Bruno, CA; 800-578-5644, 415-875-0606; www.videologic.com. *Circle 504 on reader service card.*

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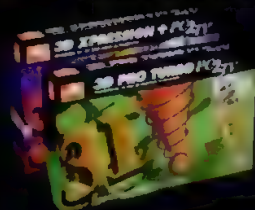
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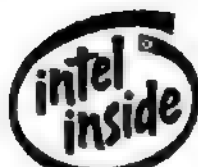
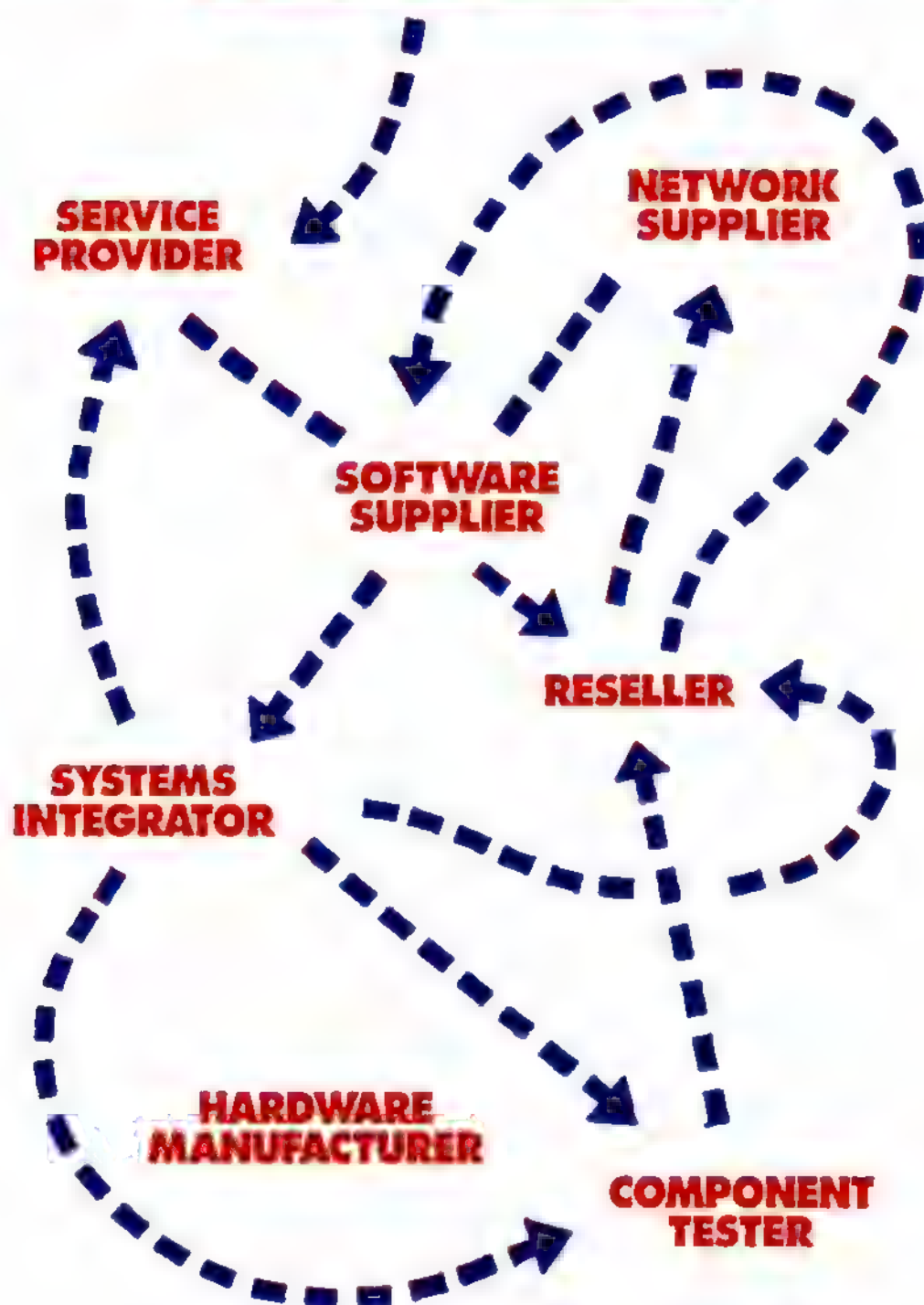
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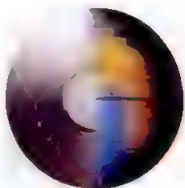
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LAB NOTES

Benchmark 97: Inside PC Labs' Latest Tests

High-end 32-bit applications and GDI playback are highlights of our new PC benchmark tests.

By Mark L. Van Name and Bill Catchings

With this issue's reviews of systems and graphics adapters, PC Magazine Labs introduces the latest versions of its industry-standard PC benchmark test programs: Winstone 97, Version 1.0, and WinBench 97, Version 1.0. The highlights of these new releases include the move to full 32-bit test suites, the debut of new technology for measuring graphics subsystem

performance, and the inclusion of application-based tests built on high-end software, such as image editors and compilers.

Winstone 97 represents the most dramatic change in the Winstone tests since this application-based benchmark program was first released. Like previous Winstone versions, Winstone 97

uses scripts that utilize real applications to produce an overall measure of a PC's performance under Windows. Unlike previous versions, Winstone 97 includes both top-selling Windows business applications and a selection of particularly demanding high-end applications. Because its tests are entirely 32-bit, Winstone 97 will run only under Windows 95 or Windows NT.



IN THIS SECTION



TUTOR It's amazing to think that rich, full-color images can be represented by a sequence of 1s and 0s, but that's all your computer sees when you see a beautiful photograph of a sunset on your screen. Jeff Prosise explains how several of the more common image bitmap file formats perform this translation. *Page 321.*

POWER PROGRAMMING



Microsoft's Component Object Model holds the promise of allowing programs to access modular code and data seamlessly, but the actual implementation of COM objects is a painstaking process—until now, that is. Find out how the ActiveX Template Library can eliminate much of the drudgery from COM programming. *Page 333.*

UTILITIES



Windows 95 includes a handy feature called Quick View, which will display files for you even if you don't have a copy of the program that

created the file. But Microsoft forgot several important graphics image file formats, including GIF and JPEG. We supply you with viewers that enable Quick View to handle seven additional file types. *Page 343.*

ALSO IN THIS ISSUE In PC Solutions, we take a closer look at the Windows 95 System Policy Editor, tell you how to change the menu item order in Windows 95, explain how to upgrade FoxPro applications for the year 2000, and much more. *Page 375.*

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WinBench 97 acts as a subsystem-level companion to Winstone 97. WinBench 97 provides detailed information about the performance of all of a PC's major subsystems: processor/RAM, graphics, disk, CD-ROM, and full-motion video playback. Like Winstone 97, WinBench 97 uses 32-bit tests exclusively, so it will run only under Windows 95 or Windows NT.

BENCHMARK TEST CONCEPTS AND DESIGN

Winstone 97 and WinBench 97 share a few key underlying concepts. As in previous releases, both offer a variety of market-centered tests based on business applications. The goal of these tests is to measure the level of performance typical users will achieve while performing common operations with leading business software. This year's releases go farther than our prior versions did in providing tests based on high-end applications.

Winstone 97 and WinBench 97, however, follow different approaches to the job of measuring PC performance. Winstone 97 runs real applications through a series of scripted activities and uses the time a PC takes to complete those activities to produce its test scores. WinBench 97, by contrast, executes synthetic program routines designed to model certain types of application behavior.

Winstone 97 and WinBench 97 also differ in the level at which they measure performance. Winstone 97 gauges the performance of an entire PC. Although you can use it to gauge the overall performance effect of an individual PC subsystem, such as a new graphics adapter, it can report only system-level results. By contrast, WinBench 97's tests measure the performance of specific PC subsystems, such as the graphics or disk subsystem. Combining the benchmark programs gives you the best of both worlds:

With Winstone 97, you can measure overall performance, and with WinBench 97 you can drill down and determine the speeds of individual subsystems.

The challenge in creating a synthetic benchmark program like WinBench 97 is making sure its tests really do act like the applications whose behavior they are supposed to reflect. WinBench 97 primarily uses a Ziff-Davis-proprietary technology, Playback, to do this. As its name suggests, Playback replays the actual subsystem-level Windows calls Winstone 97 applications make while executing

Winstone applications, but WinBench 97's ability to play back graphics logs is a significant new capability. When the graphics tests are running, the display looks just as it would during the Winstone 97 tests. Under the covers, however, only the graphics calls are executing. The result of this Playback technology is, in our opinion, the most accurate graphics and disk subsystem performance tests ever designed.

WINSTONE 97

Winstone 97 measures PC performance by running actual 32-bit applications under Windows 95 or Windows NT. As we noted earlier, Winstone 97 is based on both business and high-end applications. To determine which business applications to use, we consulted with Computer Intelligence/InfoCorp (CII), a leading market-research firm (and a division of Ziff-Davis). We chose the applications with the largest market shares by averaging actual application sales to date for 1996 with projections for 1997. The result was the following set of eight applications in three categories:

- **Publishing:** Adobe PageMaker 6.0, Corel Systems' CorelDraw 6, Microsoft PowerPoint 7.0.
- **Database:** Borland's Paradox 7, Microsoft Access 7.0.
- **Word Processing and Spreadsheets:**

Lotus WordPro 96, Microsoft Excel 7.0, Microsoft Word 7.0.

Each application's market share also acts as its relative weight in the overall Business score Winstone 97 produces.

PC Magazine editors, ZDBOp staff, and editors from other ZD publications collectively chose for Winstone 97 the following six high-end applications (in three categories). Because of the very different user communities these application categories

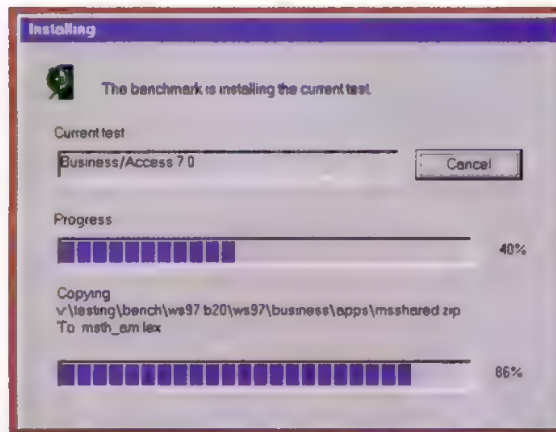


FIGURE 1: Winstone 97 provides more information than ever before during the setup and restoration phases of its application tests.

Winstone scripts. Using ZD-proprietary tools, Ziff-Davis Benchmark Operation (ZDBOp) developers recorded logs of the graphics and disk activity of the Winstone 97 applications. These logs contain every graphics or disk call the applications make. When a WinBench graphics or disk replay test starts, it uses these logs, which are on the PC Benchmarks CD-ROM, to literally replay those stored calls.

Previous releases of WinBench were able to play back the disk activity of the associated

HIGHLIGHTS

Winstone 97 and WinBench 97

- Winstone 97 and WinBench 97 run under 32-bit Windows (Windows 95 or Windows NT). All tests in both benchmark programs are 32-bit tests.
- Winstone 97 now includes applications in both Business and High-End categories. The eight Business applications continue to reflect tasks that average users perform with leading business programs. The High-End applications let you see how well a PC performs with especially demanding programs, such as Adobe Photoshop and Microsoft Visual C++.
- Winstone 97 gives an overall test score for the High-End applications, a score for

any of the three High-End subcategories, or a score for any of the six individual High-End applications.

- Applications in Winstone 97's Business category reflect new market-share data for 1996 and projections for 1997.
- WinBench 97 features Graphics Playback, a new Ziff-Davis technology for measuring graphics performance. WinBench 97 replays all graphics activity of the Winstone 97 applications, giving the most accurate measurement of graphics subsystem performance to date.
- WinBench 97 complements Winstone 97's application-based tests by including

graphics and disk tests in both Business and High-End categories. All tests use ZD's Playback technology to replay the graphics or disk activity of the Winstone 97 applications.

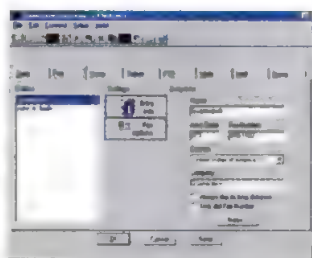
- WinBench 97 reports the processor utilization during disk, CD-ROM, and video tests.
- WinBench 97 provides a set of 30 DirectDraw inspection tests you can use to gauge a system's DirectDraw performance.
- Winstone 97 contains dramatically improved system cleanup features. It can return your system to its original state even if your PC loses power while running the benchmark tests.

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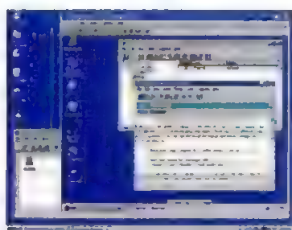
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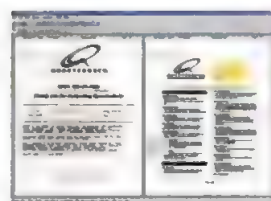
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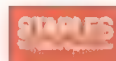
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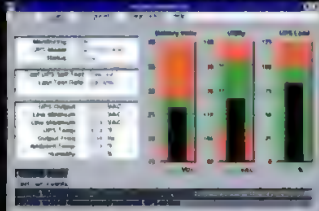
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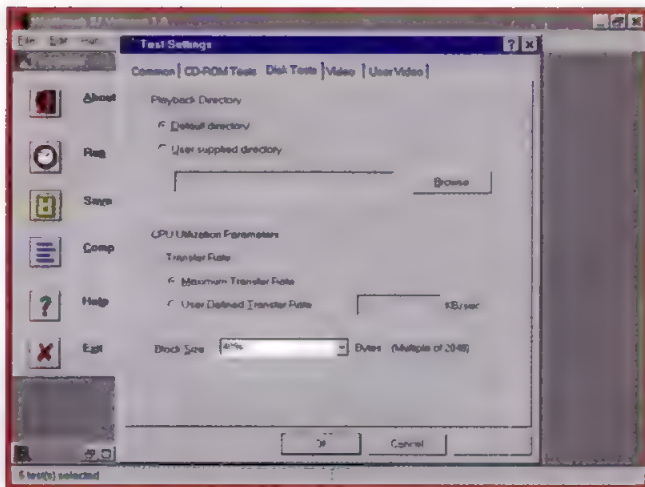


FIGURE 2: WinBench 97 makes it easy to set parameters that apply to all tests in a single WinBench test run.

address, all six applications are given equal weight in the overall High-End score Winstone 97 produces.

- **Applications Development:** Microsoft Visual C++ 4.1.
- **CAD/3-D:** Advanced Visual Systems' Application Visualization System (AVS) 3.0, Bentley Systems' MicroStation 95, Visual Numerics' PV-Wave 6.0.
- **Image Editing:** Adobe Photoshop 3.0.5, Micrografx's Picture Publisher 6.0.

As in previous Winstone releases, Winstone 97's business application scripts reflect the results of an extensive survey of the application activity of subscribers to several Ziff-Davis magazines. The scripts for the high-end applications are the results of a collaboration among ZDBOP developers, *PC Magazine* editors, and the application vendors.

Once a PC has completed the scripts, Winstone 97 produces its scores. Winstone 97 can produce more scores than ever before:

- an overall Business Winstone score, which is made up of separate Publishing, Database, and Word Processing/Spreadsheets category scores;
- an overall High-End Winstone score, which is made up of Applications Development, CAD/3-D, and Image-Editing category scores;
- and individual scores for each of the six high-end applications that we use.

Because of the different performance demands made by the business and high-end applications in Winstone 97, we used different base machines for the two groups of applications. The base machine for the Business scores was a 66-MHz 486 Gateway PC

running at 1,024-by-768 resolution with 16-bit color, with 16MB of RAM. For the High-End scores, the base machine was a Dell XPS P100c running at 1,024-by-768 resolution with 24-bit color, with 32MB of RAM. Also, the two test suites have different minimum system requirements: To run the Business tests, a system needs only 16MB of RAM, but to run the High-End tests the minimum is 32MB.

Winstone 97 computes each application score in the same basic way. It first times how long the PC takes to complete each script, then normalizes each timing against the time a base machine took to complete the same script. The benchmark program then derives a number of harmonic means from these normalized scores, using the weight assigned to each application in computing category scores—and the weight assigned to each category in computing the overall Business and High-End scores. Winstone 97 converts each overall score

running at 1,024-by-768 resolution with 16-bit color, with 16MB of RAM. For the High-End scores, the base machine was a Dell XPS P100c running at 1,024-by-768 resolution with 24-bit color, with 32MB of RAM. Also, the two test suites have different minimum system requirements: To run the Business tests, a system needs only 16MB of RAM, but to run the High-End tests the minimum is 32MB.

As you might expect from a benchmark program that utilizes 14 different applications, Winstone 97 is big. It contains about 150MB of data, so online and disk distribution is not really practical. Like its predecessor, Winstone 96, Winstone 97 is available only on CD-ROM.

You can run Winstone 97 three ways: from a local hard disk, from a CD-ROM drive attached to the PC you're testing, or from a network server. In each case, Winstone 97 copies the files each application needs to run to a working directory (which should be on the hard disk of the PC you're testing), and then it runs the application's script from that directory. All three methods yield the same results.

WINBENCH 97

WinBench 97 takes the familiar Graphics WinMark and Disk WinMark tests into new realms by providing both Business and High-End versions of each of these tests. As you would expect, the tests reflect the graphics and disk activities of the Winstone 97 business and high-end applications. WinBench 97 also continues to offer tests of the performance of a PC's processor/RAM, CD-ROM, and full-motion video subsystems, and it adds a new set of 30 inspection tests that let you get a feel for a PC's DirectDraw performance.

Historically, WinBench's most widely used score has been the Graphics WinMark score. As we noted earlier in this article, WinBench 97's Business and High-End Graphics WinMark 97 tests actually play back all the graphics and disk activities of the corresponding Winstone 97 applications. WinBench 97 can produce graphics scores corresponding to all the scores Winstone 97 can produce. WinBench 97 normalizes all of these scores against those of the appropriate Winstone 97 base machine. But the Graphics WinMark score is by no means the same as any of Winstone 97's scores. WinBench 97 produces the Graphics WinMark score by running a series of intense graphics stress tests.

OTHER WINBENCH TESTS

The other long-standing WinBench test suite consists of Disk WinMark tests, which, like the Graphics WinMark tests, now come in two versions: Business and High-End. The Disk WinMark 97 tests play back all the timed application disk activity in Winstone 97. In the course of such operations, the tests use many directo-

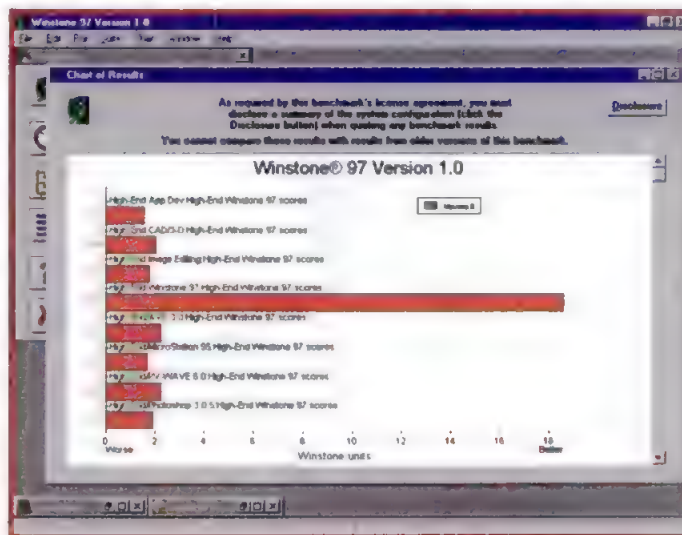


FIGURE 3: Winstone 97 combines the familiar user interface and result-reporting capabilities of previous versions with new high-end tests; you can now gauge PC performance using applications such as Adobe Photoshop and Microsoft Visual C++.

to a number relative to the overall score of the base machine, which we set to 10.0. Higher scores represent better performance. For example, a machine with an overall score of 20.0 is basically twice as fast on these market-centered applications as the base machine.



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How to Get Copies of the New Benchmark Tests

If you would like your own copy of WinBench 97, you can download it from the Ziff-Davis Benchmark Operation (ZDBOp) home page on the World Wide Web (www.zdbop.com), or from either the PC MagNet (GO PCMAGNET) or ZDBOp (GO ZDBENCH) Forum on ZD Net, CompuServe Edition. The online version does not contain the graphics, CD-ROM, or video benchmark tests; the files they require are too large for downloading. Winstone 97, the size of which is over 100MB, is not

available for downloading either.

If you'd like a copy of the CD-ROM that contains complete versions of both benchmark programs, including online versions of their manuals, ZDBOp will mail it to you for a shipping and handling fee of \$5 (in Canada, \$6; elsewhere outside the U.S., \$7). Just send a postcard to the following address:

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ries, hundreds of files, and roughly 90MB of disk space for the Business tests and 370MB of disk space for the High-End tests. A new feature lets you determine the extent of system processor utilization during each test run.

WinBench 97 offers two processor subsystem test suites: CPUmark₃₂ and CPUmark₁₆. As you'd expect, CPUmark₃₂ is a 32-bit test suite that reflects the processor usage of 32-bit applications, while CPUmark₁₆ (the sole 16-bit suite in WinBench 97) mirrors the processor behavior of 16-bit applications.

The CD-ROM WinMark 97 tests replay the CD-ROM operations of six leading CD-ROM applications in three categories: Business/Productivity, Games and Entertainment, and Reference and Education. For those seeking lower-level CD-ROM performance data, WinBench 97 provides a large assortment of additional CD-ROM read and seek tests. (To run any of these CD-ROM tests, you must have the PC Benchmarks CD in your CD-ROM drive.) With any of these tests, WinBench 97 can also report processor utilization.

WinBench 97 lets you test video playback performance with two types of clips (one of a person talking and the other of a moving carousel), at a variety of data rates and frame rates,

and with either the Indeo or the Cinepak codec. Finally, WinBench 97 includes a set of 30 DirectDraw inspection tests. Although these tests are synthetic programs that do not reflect application profiling, they can give you a good feel for a PC's DirectDraw performance.

GETTING RESULTS

If you received one of the several million copies of the benchmark tests ZDBOp and *PC Magazine* distributed last year, the user interfaces of this year's tests will look and feel quite familiar. Making either Winstone 97 or WinBench 97 produce results is simple: Install the test program and press the Run button. As in the past, both benchmark programs also come with complete online documentation.

Making sure you achieve the most accurate and useful results possible requires more care.

Even after you've followed good testing procedures and produced a set of results, you're still only part of the way to getting value from the benchmark tests. The final step is to make meaningful comparisons. If, for example, your goal is to compare the performance of two graphics adapters, test both adapters in the same system or in two identical systems. It is also important to understand that results derived from the new benchmark releases are not comparable with the results of any previous benchmark test programs—not

even with the results of an earlier version of the same benchmark program. For example, you cannot meaningfully compare the results of Winstone 97 and last year's Winstone 96 or Winstone 32 tests.

Unlike most software upgrades, the latest versions of Winstone 97 and WinBench 97 are available for only a small shipping and handling charge (some downloadable portions are free). For details on how to get your copy, see the sidebar "How to Get Copies of the New Benchmark Tests." PC Magazine Labs will be using these new versions exclusively from now on. We encourage PC and component vendors to do the same, and so should you. If a vendor tries to quote you old benchmark test results,

ask for scores based on the new releases. □

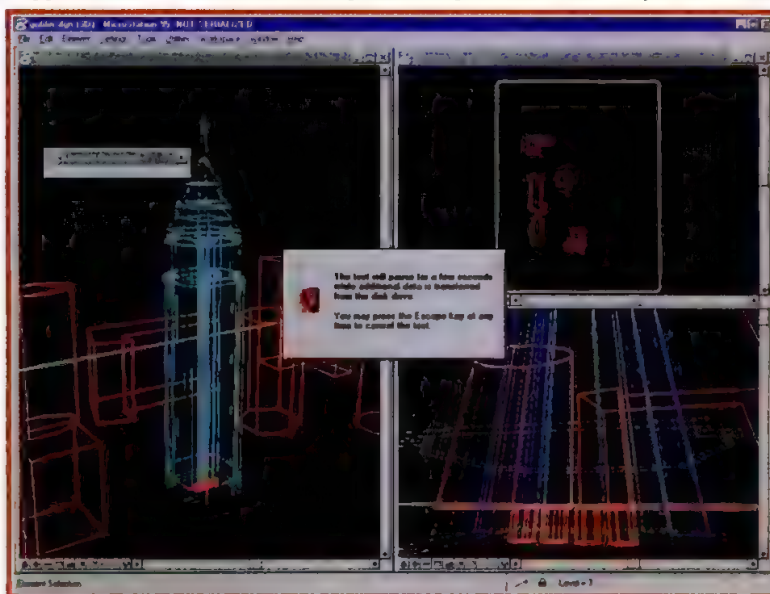


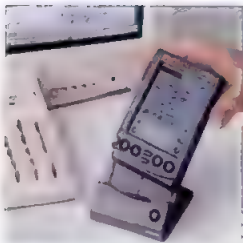
FIGURE 4: WinBench 97's High-End Graphics WinMark 97 plays back all the graphics operations of the applications in Winstone 97. This example shows WinBench 97 pausing to retrieve from disk the next set of graphics operations it needs to replay the Winstone 97 script for Bentley Systems' MicroStation 95.

The way you test, including both test procedures and system configuration options, will necessarily affect your benchmark test results. We employ a set of standard testing procedures that we also recommend you follow. The benchmark test manuals outline those procedures in detail.

Mark L. Van Name is the vice president of product testing for Ziff-Davis Publishing Co. Bill Catchings is the Director of the Ziff-Davis Benchmark Operation, a research and development division of Ziff-Davis Publishing.



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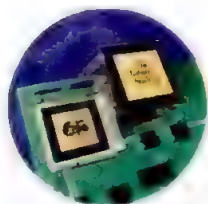
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By Jeff Prosis

A Look Inside Bitmap Files

How the most common image file formats store pictures.

Ever since I brought home my first PC more than 14 years ago, I've been fascinated by the computer's ability to store meaningful information in streams of ones and zeros. The first to catch my eye were those long BASIC program listings, once prevalent in computer magazines, with lots of DATA statements that you could type in and run to create other programs. From them I learned that any program, no matter how complex, is really just a series of numbers representing instructions to the computer's microprocessor. Next, I became interested in ASCII, and then word processor file formats, and after that—well, you get the picture.

One of the technologies that still fascinates me today is bitmap file storage. A bitmap file stores the information a computer needs to re-create a picture. You and I may see an image on the screen as a beautiful sunset, but the computer sees it as ones and zeros. It's what the computer does with those ones and zeros that enables it to reproduce the original image. Ultimately, the bits and bytes in the bitmap tell the computer what color to paint each pixel in the image. The computer then translates the colors in the bitmap into a format compatible with its display adapt-

BMP format, but the popular GIF is as foreign to Paint as Swahili is to your average Texan.

So what's inside a bitmap file, and how does one file format differ from another? To answer these questions, let's look briefly at six popular graphics file formats used on PCs. There are other bitmap file formats, of course, as well as file formats—for vector graphics, for instance—that store instructions for re-creating an image rather than color data for every individual pixel. But the bitmap file formats discussed here are the ones you're most likely to run across in the course of a day's work.

BMP FILES

The BMP (short for BitMaP) file format is the native bitmap file format for Windows—native because it closely matches the format in which Windows stores bitmaps internally. A BMP-format file typically has the filename extension .BMP, although some carry the extension .RLE, which stands for *run length encoding*. An .RLE filename extension generally indicates that the bitmap data in the file is compressed using one of the two RLE compression methods that BMP-format files support.

.BMP files encode color information using 1, 4, 8, 16, or 24 bits per pixel (bpp). The bits-

header contains information about the file, including the location in the file where the bitmap data begins. The bitmap info header contains information about the image contained in the file—for example, its height and width, in pixels. The color table contains RGB color values for the colors used in the image. On video adapters that can't display more than 256 colors at a time, programs that read and display .BMP files can program these RGB values into the adapters' color palettes for accurate color reproduction.

The format of the bitmap data in a .BMP file depends upon the number of bits per pixel used to encode color data. For a 256-color image, each pixel is represented by 1 byte (8 bits) in the bitmap data portion of the file. The pixel's value isn't an RGB color value; it's an index into the file's color table. So if the first RGB color value in a .BMP file's color table is R/G/B=255/0/0, then a pixel value of 0 in the bitmap translates to bright red. Pixel values are stored in left-to-right order, beginning (usually) with the bottom line in the image. Thus, in a 256-color .BMP file, the first byte of bitmap data is the color index of the pixel in the image's lower-left corner, the second byte is the color index of the next pixel to the right, and so on. If the number of bytes per line of bitmap data is an odd number, each line is padded with an extra byte to align bitmap data on 16-bit boundaries.

Not all .BMP files are structured like the one shown in the diagram on the next page. For example, 16- and 24-bpp .BMP files don't have color tables; instead, pixel values in the bitmap specify RGB color values directly. The internal storage format of the file's individual sections can vary, too. For instance, bitmap data in some 16- and 256-color .BMP files is compressed using an RLE algorithm that replaces runs of identical pixels in the image with tokens specifying the number of pixels in the run and their color. And Windows still supports OS/2-style .BMP files, which use different bitmap info header and color table formats.

PCX FILES

PCX was the first graphics file format to become a standard for bitmap file storage on IBM PCs. It was the format used by ZSoft's PC Paintbrush program, which was licensed to Microsoft in the early 1980s, distributed with

POPULAR BITMAP FILE FORMATS AT A GLANCE

Format	Maximum bits per pixel	Maximum number of colors	Maximum image size	Compression methods	Multiple images
BMP	24	16,777,216	65,535 by 65,535 pixels	RLE*	
GIF	8	256	65,535 by 65,535 pixels	LZW	✓
JPEG	24	16,777,216	65,535 by 65,535 pixels	JPEG	
PCX	24	16,777,216	65,535 by 65,535 pixels	RLE	
PNG	48	281,474,976,710,656	2,147,483,647 by 2,147,483,647 pixels	Deflation (LZ77 variant)	
TIFF	24	16,777,216	4,294,967,295 pixels total	LZW, RLE, and others*	✓

* Compression is optional

er and outputs them to the video hardware.

The interesting part of the process is how the computer interprets the data in the bitmap. Bitmap files come in many formats, and each format has its own way of encoding pixel data and other information indigenous to computerized images. That's why the Paint program that comes with Windows 95 will read .BMP files but not .GIF files. Paint's creators endowed the program with the ability to decode image data stored in

per-pixel count, also known as the image's *color depth*, determines the maximum number of colors the image may have. A 1-bpp image is limited to 2 colors, while a 24-bpp image can contain more than 16 million different colors.

The illustration on the next page shows the structure of a typical .BMP file containing a 256-color (8-bpp) image. The file is divided into four main sections: a bitmap file header, a bitmap info header, a table of color values, and the bitmap data itself. The bitmap file

Microsoft products, and later converted into Windows Paintbrush and distributed with Windows. Although use of this popular format is diminishing, PCX-format files, which are easily identifiable by their .PCX extension, are still commonplace today.

.PCX files are divided into three sections, in the following order: a PCX header, the bitmap data, and an optional color table. The 128-byte PCX header contains several fields, including the image size and the number of bits per pixel used to encode color information. Bitmap data is compressed using a simple RLE compression method, and the optional color table at the end of the file contains 256 RGB color values specifying image colors. The PCX format was originally developed for CGA and EGA display adapters and was later modified to support VGA and true-color adapters. Color data in modern-day PCX images can be encoded with 1, 4, 8, or 24 bits per pixel.

TIFF FILES

While PCX is among the simplest of all the bitmap file formats to decode, TIFF (Tagged Image File Format) is one of the toughest. TIFF files have an extension of .TIF. Each begins with an 8-byte image file header (IFH), whose most important member is a pointer to a data structure known as an image file directory (IFD). An IFD is a table that identifies one or more variable-length chunks of data called *tags*, which hold information about the image. The TIFF file format specification defines more than 70 different types of tags. One type, for example, stores the image's width in pixels; another stores its height. Another tag type stores a color table (if required), and yet another holds the bitmap data itself. An image encoded in a TIFF file is wholly defined by its tags, and the file format is highly extensible because additional features can be added simply by defining additional tag types.

So what is it that makes TIFF so complex? For one thing, writing a piece of software that understands all the different tag types is no easy undertaking. Most TIFF readers implement only a subset of the tags; that's the main reason a TIFF file created by one application sometimes can't be read by another. Programs that create TIFF files can also define private tag types that are meaningful only to them. TIFF readers can skip tags they don't understand, but there's always a possibility that doing so will affect the appearance of the image.

Another complication is that a TIFF file can contain multiple images, each accompanied by its own IFD and set of tags. The bitmap data in a TIFF file may be compressed using any of a number of methods, so a robust TIFF reader has to include an RLE decompressor, an LZW (Lempel-Ziv-Welch) decompressor, and several others. To make matters worse, LZW decoders must enter into a license agree-

ment with—and often pay royalties to—Unisys Corp. in order to use the LZW algorithm. As a result, even some of the best TIFF readers throw up their hands when they encounter an LZW-compressed image.

Despite its complexities, the TIFF file format is one of the best for transferring bitmaps across platforms, because it is flexible enough to allow virtually any image to be encoded in binary form without losing any of its attributes, visual or otherwise.

.GIF FILES

When most graphics gurus think of LZW, they also think of GIF (Graphics Interchange Format; pronounced "jiff"), the popular interplatform bitmap file format created by CompuServe. GIF files normally have the filename extension .GIF, and thousands of them are available on CompuServe.

The organization of a .GIF file depends on which version of the GIF specification the file conforms to. Currently there are two versions, GIF87a and GIF89a. The former is the simpler of the two. Regardless of the version number, a .GIF file begins with a 13-byte header that contains a signature identifying the file as a .GIF file, the GIF version number, and other information. If the file contains just one image, the header is usually followed by a global color table defining the colors in the image. If the file contains multiple images (GIF, like TIFF, allows two or

more images to be encoded in a single file), then the global color table is often omitted and each image may be accompanied by a local color table instead.

In a GIF87a file, the header and global color table are followed by the image, which may be the first of several images strung end to end. Each image consists of a 10-byte image descriptor followed by an optional local color table and then the bitmap bits. For space efficiency, bitmap data is compressed using the LZW compression algorithm.

GIF89a files are structured similarly, but they can also include optional extension blocks containing additional information about each image. The GIF89a specification defines four types of extension blocks: *graphics control extension blocks*, which describe how an image should be displayed (for example, whether it should overlay a previously displayed image like a transparency or simply replace it); *plain-text extension blocks*, which contain text to be displayed with the image; *comment extension blocks*, which store comments in the form of ASCII text; and *application extension blocks*, which store data private to the application that created the file. Extension blocks can appear virtually anywhere in the file after the global color table.

GIF's primary strengths are its widespread popularity and its compactness. But it has two rather severe weaknesses. One is that images stored in .GIF files are limited to a maximum of 256 colors. The other, perhaps more significant, is that software developers who use GIF in their applications must strike a license agreement with CompuServe and pay royalties on every copy sold—a policy CompuServe adopted after Unisys announced it would start enforcing its patent rights and require users of LZW compression to pay royalties. The resulting legal morass is a disincentive for programmers to implement support for .GIF files in their graphics applications.

.PNG FILES

The PNG (Portable Network Graphic; pronounced "ping") file format was developed as a replacement for GIF in order to circumvent the legal issues surrounding the use of .GIF files. PNG inherits many features from GIF and also supports true-color images. More important, it compresses bitmap data using a variation of the highly regarded LZW77 compression algorithm, a precursor of LZW that anyone is free to use. Because space is growing short, I won't take the time to discuss PNG internals. If you'd like to know more about PNG, check out the references at the end of this column.

JPEG FILES

The JPEG (Joint Photographic Experts Group; pronounced "jay-peg") file format was developed by C-Cube Microsystems to provide an

THE BMP FILE STRUCTURE

Bitmap file header (14 bytes)

BMP file signature (2 bytes)	-----	
File size (4 bytes)	-----	
Unused (2 bytes)	-----	
Unused (2 bytes)	-----	
Location of bitmap data (4 bytes)	-----	

Bitmap info header (40 bytes)

Length of this header (4 bytes)	-----	
Image width (4 bytes)	-----	
Image height (4 bytes)	-----	
Number of color planes (2 bytes)	-----	
Bits per pixel (2 bytes)	-----	
Compression method (4 bytes)	-----	
Length of bitmap data (4 bytes)	-----	
Horizontal resolution (4 bytes)	-----	
Vertical resolution (4 bytes)	-----	
Number of colors in the image (4 bytes)	-----	
Number of important colors (4 bytes)	-----	

Color table (length varies from 8 to 1,024 bytes)



Bitmap data (length varies)



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efficient method of storing deep-pixel images, such as scanned photographs, which are characterized by numerous subtle (and sometimes not so subtle) variations in color. The greatest difference between JPEG and the other file formats discussed here is that JPEG uses a lossy, not a lossless, compression algorithm. Lossless compression preserves image data, so that a decompressed image matches the original image exactly. Lossy compression sacrifices some image data in order to achieve greater compression ratios. A decompressed JPEG image rarely matches the original exactly, but very often the differences are so minor that they are barely detectable, if at all.

JPEG image compression is a complex process that frequently requires a hardware assist to achieve acceptable performance. First, the image is tiled into blocks that measure 8 pixels to a side. Each block is then compressed separately, in three stages. The first stage involves using a discrete cosine transform (DCT) formula to convert the 8-by-8 block of pixel data into an 8-by-8 matrix of amplitude values representing different frequencies (or rates of color change) in the image. In stage two, the values in the amplitude matrix are divided by the values in a quantization matrix that's biased to filter out amplitudes that are less important to the overall appearance of the image. In the third and final stage, the quan-

tized amplitude matrix is compressed using a lossless compression algorithm.

Because the quantized matrix lacks much of the high-frequency information of its predecessor, it frequently compresses to half its original size or less. Lossless compression methods are often unable to compress real-life photographic images at all, so a 50-percent reduction is quite good. On the other hand, lossless compression methods can reduce some images by 90 percent. Such images are poor candidates for JPEG compression.

The lossy part of the JPEG compression is stage two. The higher the values in the quantization matrix, the greater the amount of information discarded from the image, and the more tightly the image is compressed. The trade-off is that higher quantization values result in poorer image quality. When a JPEG image is generated, its creator chooses a quality factor, whose value drives the values in the quantization matrix. The optimal quality factor—the one that exhibits the best balance between compression ratio and image quality—is different for every image and is usually found only through trial and error.

FURTHER READING

Several books are available on computer graphics file formats, but one that I've found particularly helpful (and well written) is

James D. Murray and William van Ryper's *Encyclopedia of Graphics File Formats*, Second Edition (O'Reilly & Associates, 1996). It documents the history and internals of more than 100 file formats, ranging from Adobe Illustrator to ZBR. Curiously, it's silent about one of the most common formats of all—BMP—but there's plenty of information available on .BMP files elsewhere. "Further Information" sections accompanying the descriptions of each format tell you where you can get specifications and other information and also include URLs for hundreds of helpful Web sites.

Another book that I've found to be invaluable is Steve Rimmer's *Windows Bit-mapped Graphics* (Windcrest/McGraw-Hill, 1993). In addition to documenting the formats of .GIF, .PCX, .BMP, .WPG, .TIFF, .TGA, and MacPaint files in great detail and also describing many of the quirks and variations commonly found in files of these types, Rimmer provides C source code for Windows applications that read and display images stored in each of the different formats. His book deserves a place on the shelf of anyone interested in popular computer graphics file formats. □

Jeff Prosize is a contributing editor of PC Magazine.

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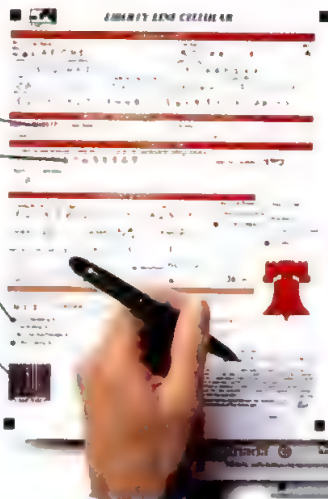
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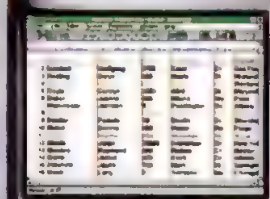


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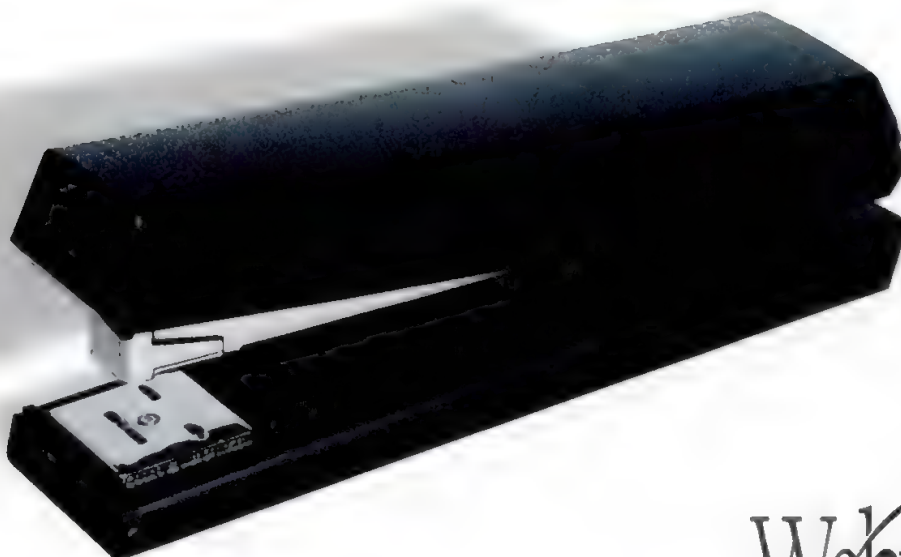
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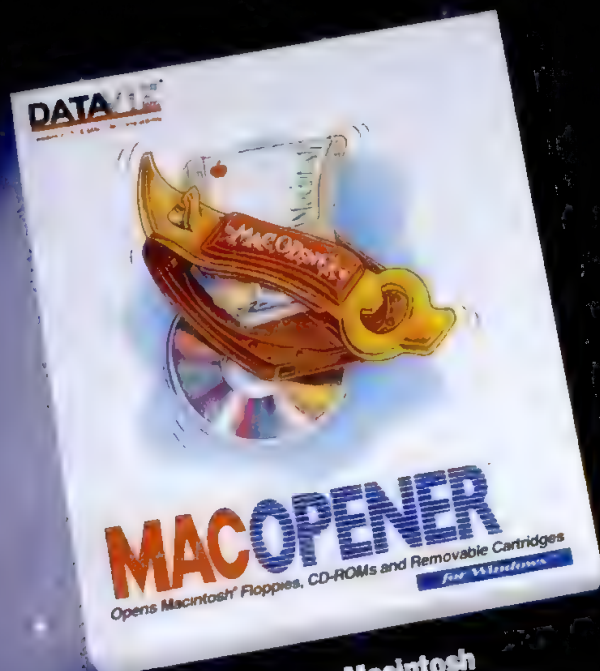


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PC Tech/Power Programming

By John Lam

ATL: Rx for Your COM Headaches

Microsoft's ActiveX Template Library automates COM programming.

From all you've read about Microsoft's Component Object Model (COM) specification by now, you can probably detect one recurring theme: It's a source of a lot of headaches. If you've been developing COM objects with the current tools, you're certainly familiar with the pain. But if you're just beginning with COM development, you can relax. Many tools are now available that can spare you a lot of suffering.

The main source of most COM headaches is bookkeeping chores. No sane developer likes bookkeeping, but it's an unavoidable fact of life. The Windows Registry must account for each COM object, and typically, the developer must manually maintain tables of information required by the COM specification and by Windows.

Each COM object must be identified by a unique class identifier (CLSID). Each custom interface (that is, one not predefined by Microsoft) must also be identified by a unique interface identifier (IID). Both CLSIDs and IIDs are types of Globally Unique Identifiers (GUID). All these various numbers, along with human-readable descriptions of what they mean, must be stored in the Registry, and that means more code for the developer to write and maintain.

Unfortunately, your headaches don't stop there. All COM objects must be reference-counted. That is inherently a good thing, since it allows a COM object to manage its own memory. But under the COM implementation, it is our poor developer who has to write all the error-prone code that deals with maintaining his own object's reference count—not to mention those of other objects that it references!

In fact, the number-one barrier to many developers' using COM in their applications is the sheer amount of minute detail they must understand before they can write or control even the simplest COM object. Some of these tasks cry out for automation, and in this day and age of fast computers, smart compilers, and richly featured integrated development environments, some simplification should indeed be possible.

To a certain extent, it now is.

In order to lay the groundwork for helping you understand Microsoft's new toolkit for

building COM objects, the ActiveX Template Library (ATL), this column will take a look at Microsoft Foundation Classes (MFC) and what they do for your COM development. We'll also discuss C++ templates, then conclude with a conceptual overview of what ATL brings to the party. Later, in a follow-up article, we'll get down to the business of actually building a COM object using ATL.

You can freely download Version 1.1 of ATL from Microsoft's Web site, at www.microsoft.com/visualc/v42/atl. You'll need Visual C++ 4.1 or higher to use it.

HOW MFC ADDS TO THE HEADACHES

First let's think about what a framework like MFC offers COM programmers. MFC delivers an implementation of the required IUnknown interface in its CCmdTarget base class. It also directs incoming calls on a COM object's various COM interfaces to the appropriate handlers using a mechanism similar to CCmdTarget's means for dispatching Windows messages.

```
class CValidate : public CCmdTarget
{
protected:
    DECLARE_INTERFACE_MAP()

    // IValidate Interface
    BEGIN_INTERFACE_PART(Validate, IValidate)
        STDMETHOD(Foo)();
    END_INTERFACE_PART(Validate)
};

// IValidate Interface

BEGIN_INTERFACE_MAP(CValidate, CCmdTarget)
    INTERFACE_PART(CValidate, IID_IValidate, Validate)
END_INTERFACE_MAP()

STDMETHODIMP CValidate::XValidate::Foo()
{
    METHOD_PROLOGUE(CValidate, Validate);

    ::MessageBox(NULL, "Hello World", NULL, MB_OK);
    return S_OK;
}
```

FIGURE 1: A simple COM object, the MFC way.

But these conveniences do not come without a cost, whose roots lie in the single-inheritance architecture of the MFC class hierarchy. All COM objects must implement one or more COM interfaces, which are identical in form to C++ v-tables. The preferred way to generate multiple v-tables would rely on C++ multiple inheritance, a language feature, rather than on an application framework. (ATL uses that very approach, and we'll examine it in more detail later.) MFC, however, uses nested classes to create multiple v-tables for each COM object. Essentially, MFC exports the v-tables of C++ objects created inside the C++ object that contains the implementation for your COM object; these v-tables represent the COM object's interfaces. That is the approach that must be taken by all OOP languages that don't support multiple inheritance, such as Delphi. It's also the reason for all those macros—required by MFC—that obfuscate your otherwise simple code. Compare the equivalent COM objects in Figures 1 and 2. Which one do you understand more clearly?

As I mentioned earlier, CCmdTarget's mechanism for dispatching Windows messages is similar to the one used by MFC's to dispatch incoming calls on COM interfaces. The Visual C++ IDE makes it easy to add Windows message handlers to CCmdTarget-derived classes via wizards. When you want to add a new handler, Class Wizard takes care of all the details associated with creating the message map entry and the appropriate function skeleton in your code. Unfortunately, there are no additions to Class Wizard to simplify the creation of COM objects, although there is support for creating Automation objects.

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plementation of the IUnknown interface functions from the figures for clarity's sake. But it's a good example of the headaches that new—and experienced—COM developers must face on a day-to-day basis. In the MFC example in Figure 1, you can see that we add our function prototypes by using the `STDMETHOD` and `STDMETHOD_` macros between the `BEGIN_INTERFACE_PART` and `END_INTERFACE_PART` macros. Why can't we use the much simpler method in Figure 2, where we declare the functions just as we would with any other C++ class? Aren't the purpose and intent of the functions in Figure 2 much clearer?

Now look at the implementation of `Foo` in the MFC example. You'll note that it's buried inside *two* scope resolution operators. That's because, as we discussed earlier, MFC uses nested classes to implement multiple interfaces in a single COM object.

```
STDMETHODIMP
CValidate::XValidate::Foo()
```

The `BEGIN_INTERFACE_PART`, `END_INTERFACE_PART`, `BEGIN_INTERFACE_MAP`, and `END_INTERFACE_MAP` macros actually define a new class called `XValidate`, which implements the `IValidate` interface inside the `CValidate` class. We also need to use the macro `METHOD_PROLOGUE`, in order to generate a pointer to our instance of a `CValidate` object—clearly, not a very clean implementation. And that's a big part of the problem with MFC code: the fact that it is first and foremost *MFC code*, rather than C++ code. Reading and writing MFC code and reading and writing C++ code are two completely different experiences.

What we need is a cleaner implementation of COM than we can get through MFC alone. It is this problem, along with several others, that the ActiveX Template Library attempts to solve.

C++ TEMPLATES

Before we can talk about the ActiveX Template Library, let's briefly discuss what templates are. Otherwise known as parameterized types, *templates* allow developers to pass *types* as parameters. That means you can design generic, type-safe classes. Do the terms

"generic" and "type-safe" sound contradictory to you? They would have been, back in the early days of C++, before templates. But since you can now construct new typed classes from a generic template class by passing types as parameters, generic *and* type-safe classes are possible.

Templates are probably best known for allowing the creation of generic collection classes. Developers used to have to write separate classes for storing, for example, linked lists of `ints` and `floats` in a type-safe way. If they wanted to write a generic collection class (such as `COBList`, in earlier versions of MFC), they had to create the types on the heap and store void pointers to those objects in `COBList`. That technique is hardly type-safe, since it puts the burden of enforcing type-safety on the developer, rather than on the compiler.

Wouldn't it be useful to be able to create a generic collection class and still specify what type of object the collection is supposed to hold? You can, by using some of the new template classes that are part of MFC. Instead of using `COBList` and void pointers, you can use the template `CList` class. You would declare a list of `ints` using the following syntax:

```
CList<int, int&> myList;
```

The compiler will ensure that your list will hold only `ints`, and nothing else.

A SIMPLE EXAMPLE OF A TEMPLATE

To create your own template class, you would use the new `template` keyword, with an argument list enclosed by angle brackets, to define it. The arguments can specify types through the use of the `class` keyword, or they can be regular C++ arguments. Take a look at the following template-based stack class.

```
template< class TYPE, int SIZE >
class CStack
{
    TYPE data[ SIZE ];
    int end;
public:
    CStack() { end = 0; }
    void Push( const TYPE &c )
        { data[top++] = c; }
```

```
void Pop( TYPE &c ) { c = data[--top];
}
};
```

The template describes a generic `CStack` class that can contain only `TYPE` objects; the argument `SIZE` specifies the maximum number of elements it will hold. You can create any number of `CStack` objects to hold whatever types you wish:

```
CStack< int, 30 > intStack;
CStack< CPerson, 30 > personStack;
CStack< CList< int, int&>, 30 >
    CListStack;
```

The third example, you'll note, includes a template within a template.

All template declarations must be completely self-contained inside a header file. You cannot split a template declaration into separate `.h` and `.cpp` files, as you would for a normal C++ class. That's because the template expansion has to be done at compile time. In essence, whenever the compiler encounters a line of code like

```
CStack< int, 30 > intStack
```

it expands the template in-line at that point. (If you think of template files as similar to C macros, you won't forget this important point when you develop your own template classes.)

THE STANDARD TEMPLATE LIBRARY

The Standard Template Library (STL) is perhaps the most ambitious example of templates in use today. STL represents a new way of thinking about programming and is an important weapon in your arsenal as a C++ developer. Briefly speaking, STL consists of five major components:

- container classes
- algorithms
- iterators
- function objects
- adapters

STL is part of the draft ANSI C++ standard, and numerous free and commercial implementations are available. If you have Visual C++ 4.1 or earlier, you'll find the Hewlett-Packard implementation on the CD-ROM. With Visual C++ 4.2, Microsoft incorporated STL into its standard C++ library.

STL is much too large a topic to cover here, so I'll refer you to a number of excellent references on it and on template-based programming at the end of this column.

AN OVERVIEW OF ATL

First, let's note what ATL does *not* do: It is not designed to replace MFC, but to complement it. ATL does not

```
class CValidate: public IUnknown
{
public:
    HRESULT QueryInterface( REFIID iid, void** ppvObject )
    {
        return E_NOINTERFACE;
    }
    ULONG AddRef();
    ULONG Release();

    virtual HRESULT Foo() { MessageBox( 0, 'hello world', NULL, MB_OK ); };
};
```

FIGURE 2: A simple COM object, the plain old C++ way.

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provide a framework for implementing ActiveX documents, nor for creating graphical ActiveX controls. Those features require implementing many COM interfaces, a job better handled by a class library than a template library.

What ATL excels at is the creation of small, lightweight, DLL-based COM objects. By using template libraries, you compile only the classes that you explicitly reference. This makes ATL particularly useful for creating libraries of objects that can be reused much the way you would employ DLL-based code. And you have all of the advantages of COM and a truly object-oriented interface, as opposed to the flat API presented by a DLL.

Here are some of the capabilities ATL provides, with details following:

- custom (IUnknown-based) interfaces
- dual (IDispatch-based) interfaces
- Automation collections and COM enumerators through the IEnumXXX interfaces
- Connection Points
- tear-off interfaces
- aggregatable COM objects
- registration of COM objects
- apartment and free-threaded COM objects

Custom-interface COM objects provide you with the greatest flexibility and highest performance. They are created and used only by

programming languages that support both pointers and class-based inheritance, such as C++ or Delphi. Dual-interface COM objects, in contrast, trade off some of that flexibility and performance in return for a more open interface. A dual-interface COM object can readily be used by languages that do not support pointers or class-based inheritance, such as Visual Basic.

ATL makes building Automation collections easy. Since ATL implements the IEnumVariant interface for you, applications written in Visual Basic can now call your COM object using the FOR EACH...IN syntax without additional code.

Connection Points allow you to create networks of COM objects that understand how to notify each other of changes in their internal states. Whereas ordinary COM interfaces are "incoming" interfaces, the COM Connection Point protocol lets you create "outgoing" interfaces that can be used to send notifications or even broadcast messages to all connected COM objects.

The concept of a tear-off interface is unique to ATL. The v-tables that represent COM interfaces in memory are created at the same time as their COM objects, regardless of whether the objects are ever called by a client application. If you use a tear-off interface, ATL will take care of constructing the inter-

face v-table dynamically only when that interface is requested. Under certain conditions, this can help save memory.

ATL's registration services are comprehensive. The COM AppWizard takes care of generating and registering all the various GUIDs required to identify a COM object. The ATL template classes take care of actually creating the Registry entries.

That is just a small taste of what ATL can do for you. Next time, we'll go into the nitty-gritty of actually creating a COM object using ATL, starting with the ATL COM Wizard.

FURTHER READING

C++ Programmer's Guide to the Standard Template Library, by Mark Nelson (IDG Books, 1995), is an excellent and thorough introduction to STL programming.

Practical Data Structures in C++, by Bryan Flamig (John Wiley & Sons, 1993), is valuable for learning about how to implement efficient data structures using C++ and templates.

Inside OLE, Second Edition, by Kraig Brockschmidt (Microsoft Press, 1995), includes a good chapter on Connection Point interfaces. □

John Lam is president of Naleco Research (www.naleco.com), developer of RADFind 96, a high-speed file-finder utility for Windows 95.

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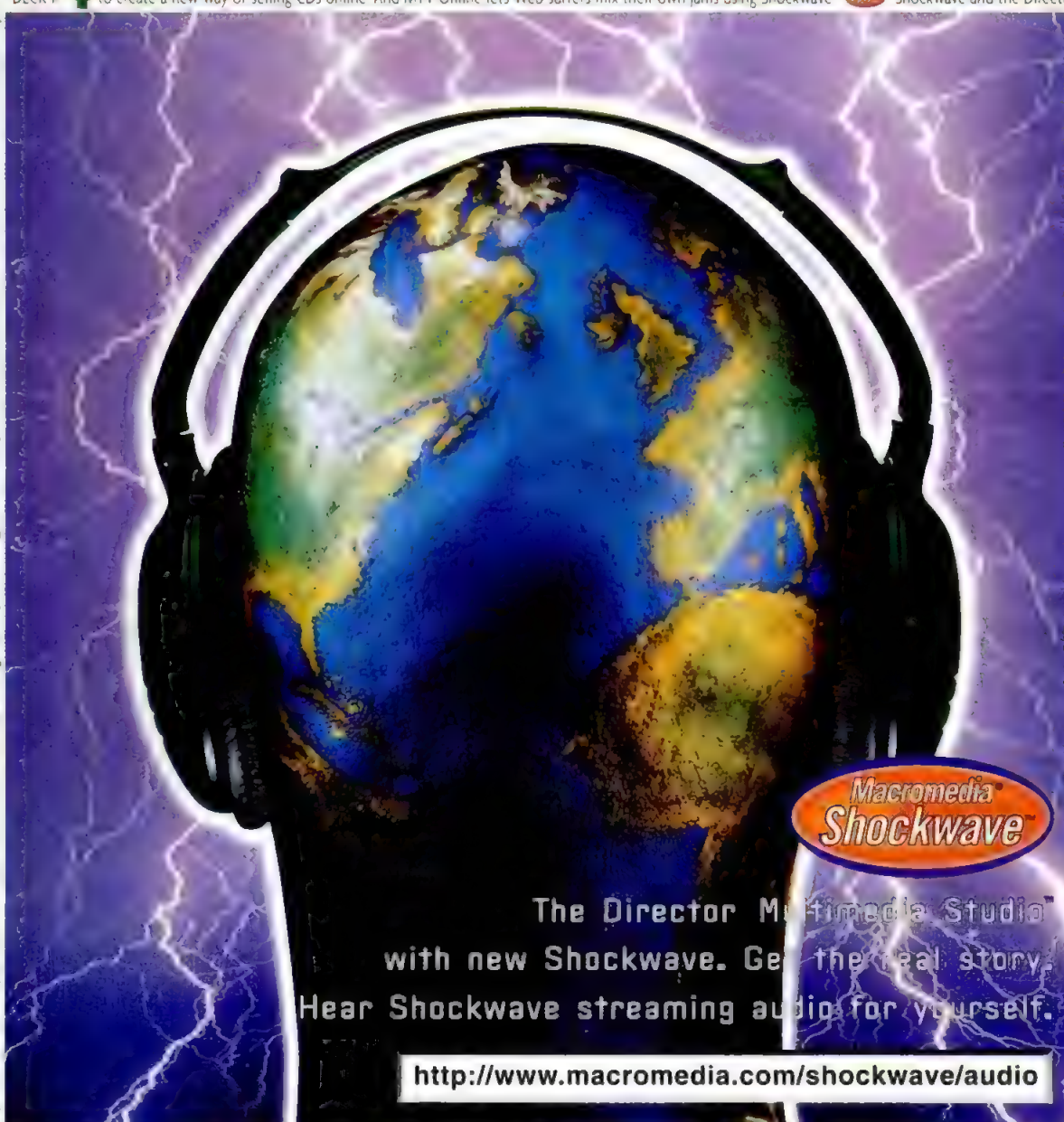


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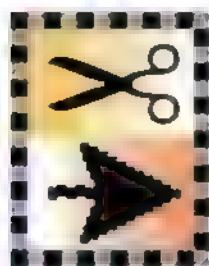
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PC Tech/Utilities

By Jeff Prosis

Viewers That Microsoft Forgot

ImgView adds seven graphics formats to Windows 95's Quick View.

As part of its strategy to make Windows a more document-centric operating system, Microsoft built support for plug-in file-viewing components known as Quick Viewers into Windows 95. Right-click on any file object in the Windows 95 shell, and if there's a viewer registered for that file type, a Quick View command will appear on the file's context menu. Select it to display the file's contents. The beauty of Quick View lies in being able to see what's inside a file even if you don't have the application that created it.

The CD-ROM version of Windows 95 comes with viewers for more than two dozen file types, including .WKX (Lotus 1-2-3) and .BMP (Windows bitmap) files, but it inexplicably lacks viewers for popular image file formats such as PCX and JPEG. You can correct that omission with ImgView, a *PC Magazine* utility that enhances Windows 95 by adding Quick View support for seven types of graphics file formats:

- GIF (.GIF files)
- JPEG (.JPG files)
- Kodak PhotoCD (.PCD files)
- PCX (.PCX files)
- PNG (.PNG files)
- TARGA (.TGA files)
- TIFF (.TIF files)

You can obtain a copy of ImgView by downloading it from PC Magazine Online or from ZD Net on CompuServe, or by requesting it through snail mail (see the sidebar "Getting the Files" for details). The source code, which was compiled with Microsoft's Visual C++, is also available.

ImgView gets its imaging power from a third-party graphics library, and while the code lets you see how the program works, you can't recompile it without purchasing the library. ImgView would have been drastically more difficult and time-consuming to program without the use of a third-party graphics

library. For more information on the library I used and how to obtain it, see the section below entitled "For Programmers Only."

INSTALLING AND UNINSTALLING

When you download ImgView, you get a .ZIP file containing two executable files named Install.exe and Uninstal.exe, plus several dynamic link libraries (DLLs). ImgView.dll is the main DLL; it houses the code for ImgView itself. The other DLLs are part of LEADTools WIN32 Pro and must not be distributed separately from ImgView.dll.

ImgView can be installed in seconds. First create a directory on your hard disk (for

ImgView to support and click on OK to complete the installation process.

A check box that is initially unchecked means Install has determined that a viewer for that format may already exist on your system. It's your choice whether to leave the existing viewer intact or to let ImgView provide a viewer for that file format (if you choose the latter, it's a good idea to uninstall the existing viewer before installing ImgView). If you don't install the complete set of ImgView viewers the first time around, you can add more later by running Install again.

Uninstalling ImgView is equally easy. Simply run Uninstal.exe, also included in the .ZIP file. Among other things, Uninstal removes the Registry entries that Install copied to the Registry. It does not, however, delete the LEADTools DLLs that Install copied from the ImgView directory to the system directory. If you'd like to free disk space by deleting those DLLs, make backups and then delete them from the system directory (C:\Windows\System on most PCs). That way, you can restore them to your hard disk if your favorite application suddenly stops running because it can't find a DLL that it needs. Here's a list of the DLLs that Install copies to the system directory:

IN THIS ISSUE

ImgView

ImgView enhances the Windows 95 Quick View facility by adding viewers for seven additional graphics formats: GIF, JPEG, Kodak PhotoCD, PCX, PNG, TARGA, and TIFF.



example, C:\ImgView) to hold the ImgView executables. Next, expand the .ZIP file in the ImgView directory.

Now, run Install.exe from the ImgView directory and answer the questions as you are prompted to do so. First you'll be asked to enter the path to ImgView.dll. Install will add this pathname to the Registry, so the system will know where to find ImgView.dll. Then you'll be presented with a list of file formats (see Figure 1). Check the formats you'd like

LFCMP61N.DLL
LFTIF61N.DLL
LFFAX61N.DLL
LFPCD61N.DLL
PCDLIB32.DLL
LFPCX61N.DLL
LFPNG61N.DLL
LFTGA61N.DLL
LFGIF61N.DLL
LTKRN61N.DLL
LTFIL61N.DLL

The applications most likely to use these

FOR PROGRAMMERS ONLY An expanded version of this article that describes how ImgView was programmed is available from *PC Magazine's* Web site at www.pcmag.com, and from ZD Net on CompuServe, in the Utilities/Tips Forum (GO TIPS). The complete source code for ImgView, which was written in C++ and compiled with Microsoft's Visual C++, is also available online, for those who would like to learn more about how to write a Windows 95 file viewer.

ImgView gets its imaging power from a third-party graphics library called LEADTools WIN32 Pro. If you'd like to tweak ImgView's code and build your own customized version, you'll need a licensed copy of this library. For details, call LEAD Technologies at 704-332-5532, or visit their Web site at www.leadtools.com. To enable support for .GIF and TIFF files in your programs, you'll also need a license from Unisys Corp. You can contact Unisys through its Web site, at www.unisys.com.

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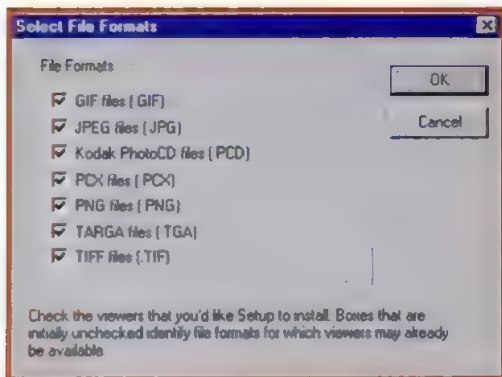


FIGURE 1: Install's Select File Formats dialog box lets you choose from a list of supported file formats.



FIGURE 2: This TIFF file, which was downloaded from CompuServe, is displayed in a Quick View window by ImgView.

DLLs are heavily graphics-intensive applications like CorelDraw.

VIEWING AND PRINTING

Once the software is installed, using ImgView is simplicity itself. Just right-click on any filename or icon with the extension .GIF, .JPG,

.PCD, .PCX, .PNG, .TGA, or .TIF and select Quick View from its context menu. (Your system may not be set to display filename extensions. In order to set it, drop down the View Menu from any Explorer window, then choose Options. On the View page, uncheck the box next to "Hide MS-DOS file extensions for file types that are registered.") The image contained in the file will be displayed in a Quick View window like the one shown in Figure 2.

ImgView's Options menu contains four commands: Copy to Clipboard, Status Bar, About This Viewer, and Exit. Status Bar turns the status bar at the bottom of the window on and off, About This Viewer displays ImgView's About box, and Exit closes the Quick View window. The Copy to Clipboard command copies the image to the Windows clipboard. With a helping hand from the Windows 95 Paint applet, you can also use it to translate graphics files to .BMP format, which allows them to be used as your desktop wallpaper. To create a .BMP file from, say, a .GIF file, follow this four-step procedure:

1. Display the .GIF file in a Quick View window.
2. Select Copy to Clipboard to copy the image to the clipboard.
3. Start Paint and select Edit | Paste to paste the image into Paint.
4. Use Paint's Save As command to save the image in .BMP format.

Copy to Clipboard can also be used to facilitate printing. To print an image, copy it to the clipboard and paste it into Paint. Then use Paint's File | Print command to transmit the image to a printer.

ImgView also supports drag-and-drop image viewing. To demonstrate, select Quick

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- 7 **PICALB** Organizes image files
- 8 **1MBF** Protects low memory
- 9 **MULTIL** Adds launch choices in Win 95
- 10 **INCTR2** Monitors program installation

View from a context menu to display a Quick View window. Then drag an image file icon from a shell folder and drop it over the Quick View window.

QUESTIONS ABOUT IMGVIEW?

If you have questions about ImgView, drop me a note in the Utilities section of PC Magazine's TIPS Forum on CompuServe. My user ID is 72241.44. From the Internet, send e-mail to 72241.44@compuserve.com or jprosis@zd.com. I prefer to field questions in the forum so that others can benefit from our discussions, but if you don't have access to CompuServe, I'll gladly respond to e-mail queries. □

Jeff Prosis is a contributing editor of PC Magazine. In addition to writing our popular Tutor column, he is the author of several books, including the recent Programming Windows 95 with MFC, from Microsoft Press.

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BY FAX OR MAIL If you don't have a modem or Internet access, you can fax 508-368-0141 or write to PC Magazine Utilities, c/o Image Software Services, 55 Green St., Clinton, MA 01510-3099.

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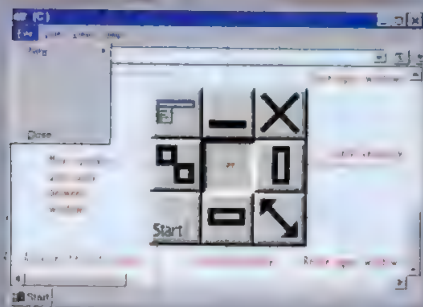
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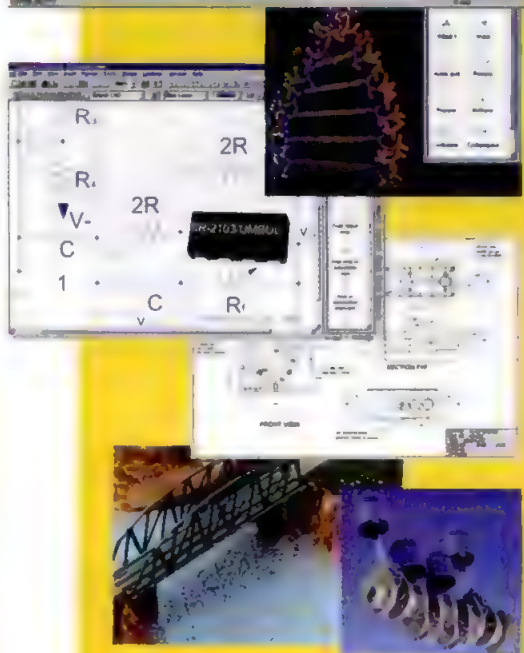
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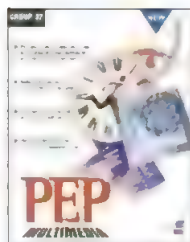
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CAD Suite Advantages

★★★★★

by Tom King.

Want to design your dream home, edit an existing house plan, or hash out a few creative changes on a CAD drawing? Can't afford the expensive software, or would like to start your own design/drafting business? Want dependable software and tools that really work together? Hint: think suite.

The advantages of suites hinges on the extra utilities or other features that make the main programs more productive. A single purchase provides this, plus the ability to correspond with a single software company if support is needed.

Caution! Creating with CAD will strip the very threads of your wallet ... unless you shop around.

The trend moving away from pricey, cumbersome programs, like AutoCAD, has apparently caught on. Take, for instance, a recent CAD suite from ViaGrafix: DesignCAD Office. This suite offers a full featured CAD system

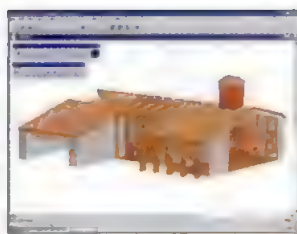
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Anything helping to save time and boost productivity must be a good deal, right? Be careful, even though there are several combo-packages available, it might be advisable to get references or read the testimonials of actual users.

So, besides my own testimonial, try this one on for size. "I use DesignCAD for my drafting students because it's much easier to learn than AutoCAD," said Bill Stone, technology instructor at Junction City High, Junction City, KS.

The extra tools in DesignCAD



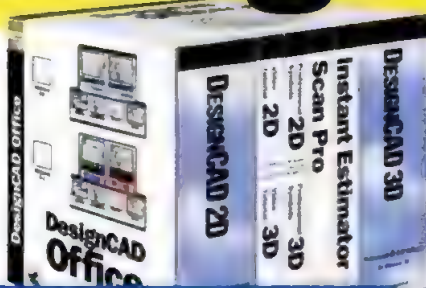
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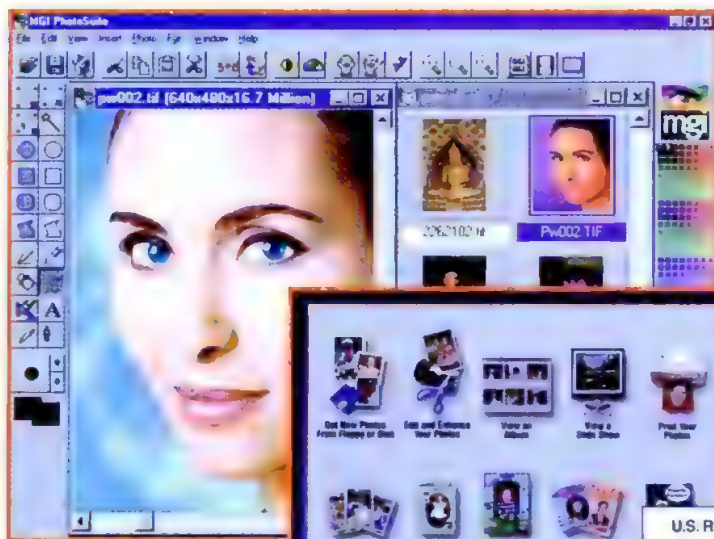
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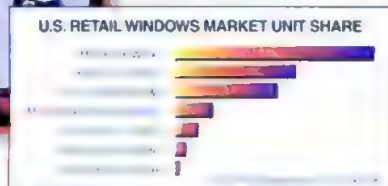
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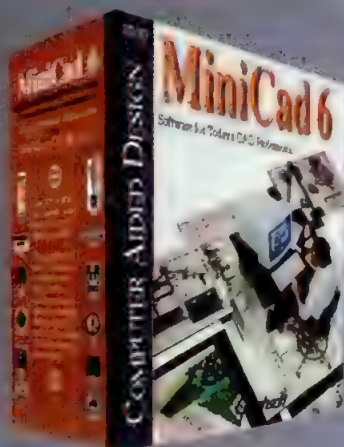
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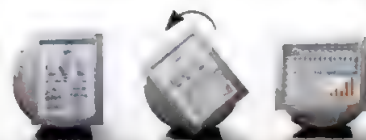
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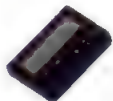
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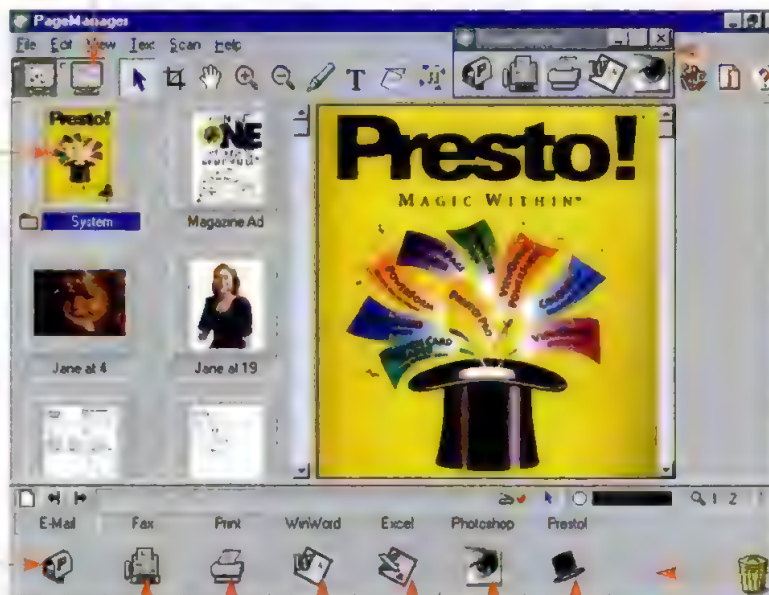
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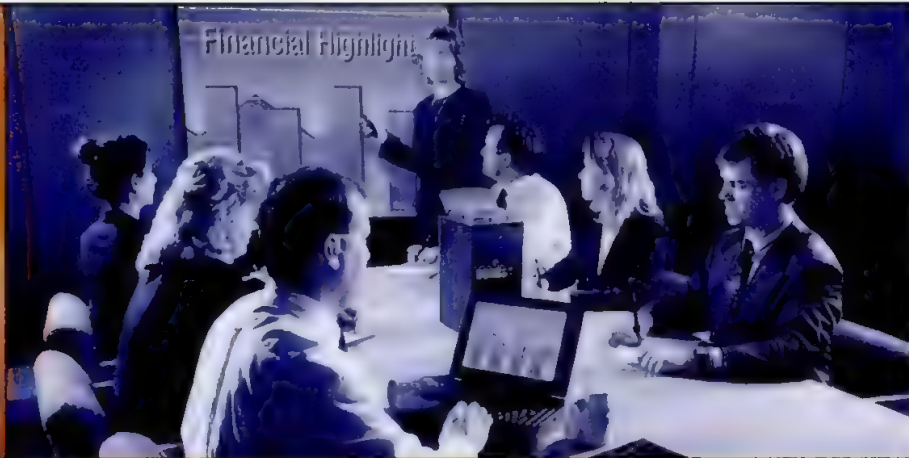
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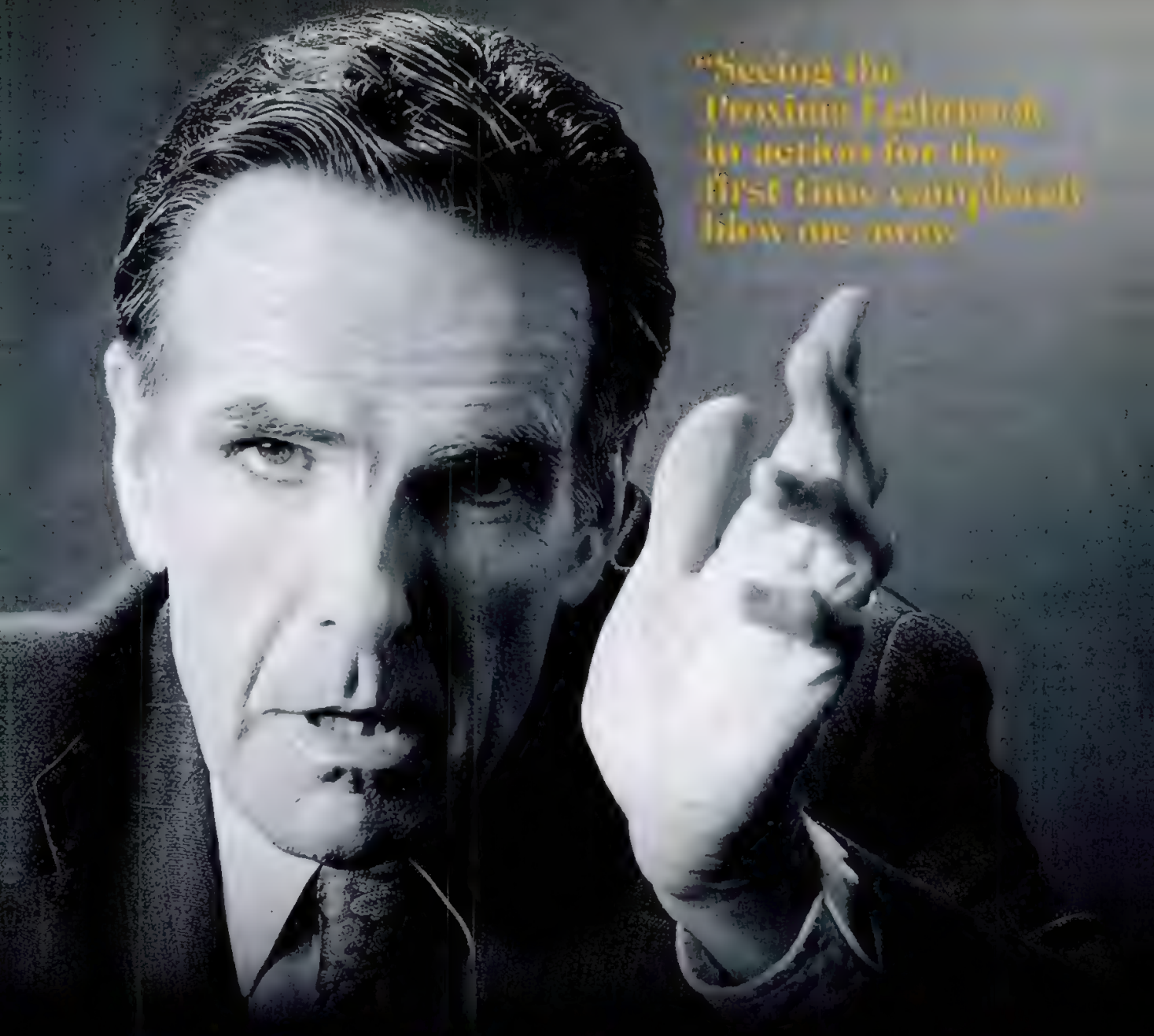
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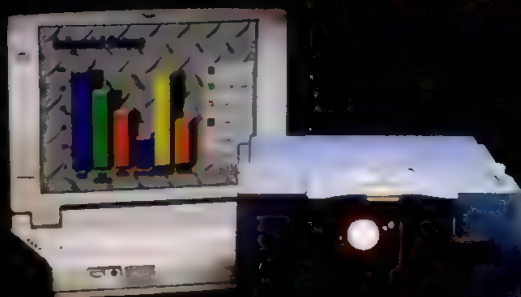
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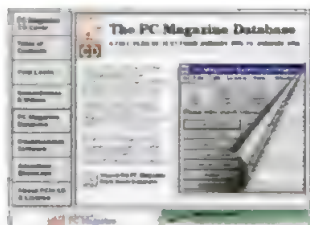
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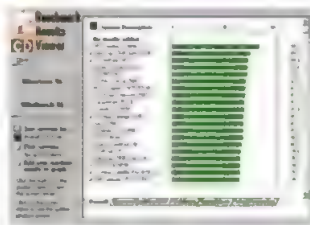
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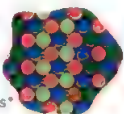
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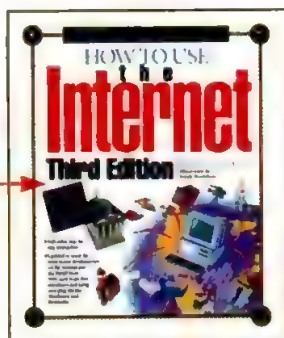


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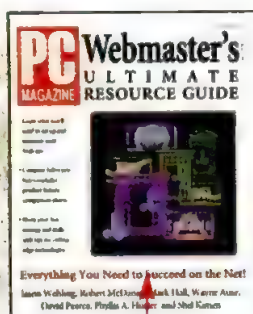
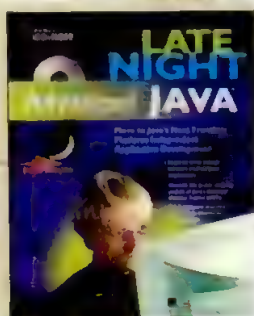
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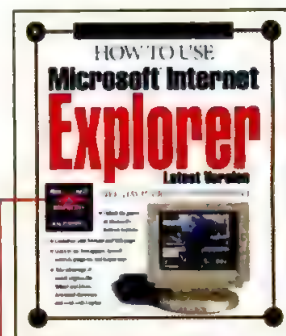
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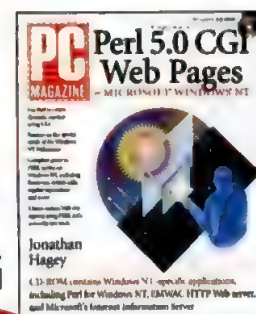
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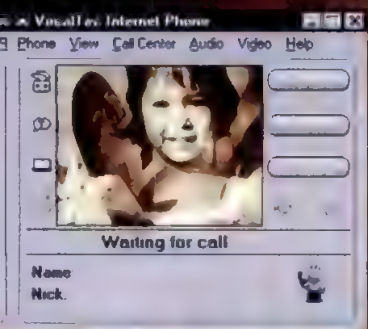
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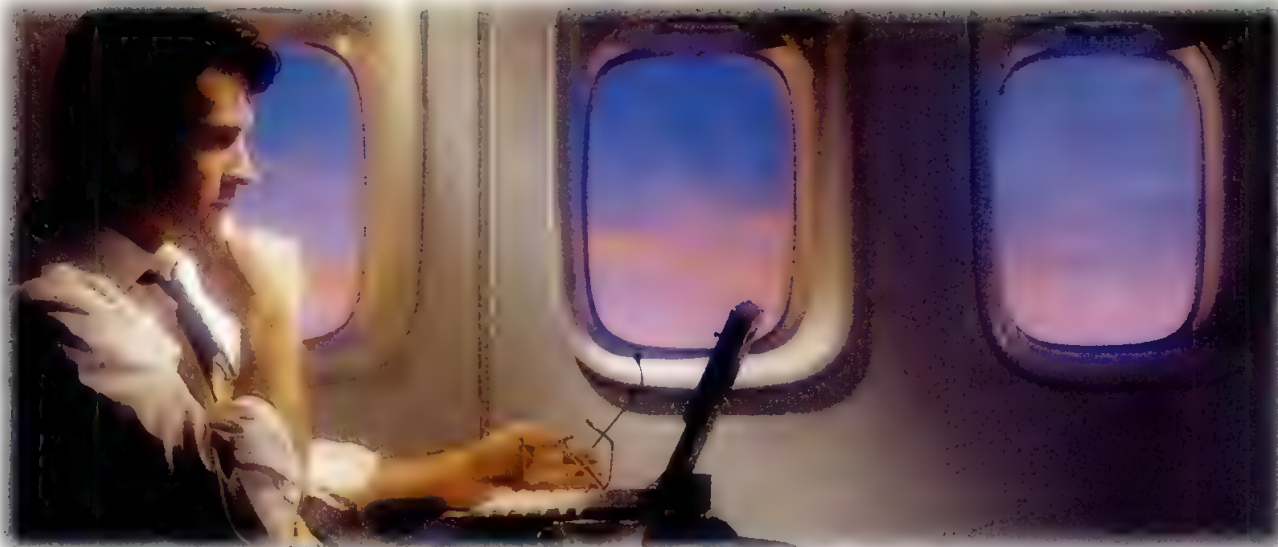
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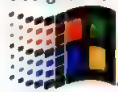
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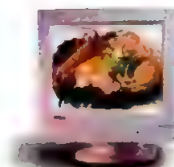
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User-to-User

By Neil J. Rubenking

Outsmarting a Virus

Some viruses, such as N64, 1465, and Dir2, share a common characteristic: When they are active in memory, a directory listing won't show any change in length. But if you reboot with a clean floppy disk, an infected file will show up as larger when you list the directory again. I've discovered that these viruses can be "cleaned" with the DOS COPY command.

To get rid of the virus, you need to execute the infected program (A.EXE, for example), so that the virus loads itself into memory. Then type the command `COPY A.EXE A.ESE`. Now reboot with a clean floppy disk and use the following command: `COPY A.ESE A.EXE`. The virus has been removed. But where does it go? I've been thinking it over for years!

LI ZENGSHENG
Xi'an, Republic of China

PC MAGAZINE: I wouldn't go so far as to suggest deliberately executing an infected program. There is always the chance that the virus's payload will be triggered, causing almost any kind of damage, from deleting files to reformatting your disk. But if you suspect a virus is already active on your system, you may as well copy the suspect files as described here before rebooting from a clean, write-protected floppy disk.

Only "stealth" viruses can be removed with this technique. When a virus of this type is resident in memory, it intercepts any attempt to read infected files from disk, substituting an image of the original, uninfected file. The purpose of this behavior is to evade detection by antivirus programs. But when you copy a file under these conditions, the virus itself substitutes an image of the original file. If the destination filename represented an executable file, the virus in memory would most likely infect it again, but viruses almost never attack data files. Thus copying the infected file to a non-executable filename will result in a clean copy of the original, courtesy of the virus's "stealth" system.

Please don't regard this as a cure for a virus infection. It's strictly a stopgap measure, something you can apply while waiting to get a true antivirus utility installed. And remember, only the complex stealth-type virus-

es can be removed in this way. A less intricate, "dumb" virus won't be affected at all.

Removing Items from The Add/Remove Programs List

For several months, I tried to figure out how to delete items from the Add/Remove Programs Properties box in the Windows 95 Control Panel. I needed to do this because I had removed several programs from my system the old way: I simply deleted them off the hard disk. I learned to uninstall programs using Add/Remove Programs, but I was stuck with entries I couldn't delete because I had already deleted the programs to which they referred. I finally discovered a technique for deleting such orphaned entries.

Select Run from the Start Menu, type `REGEDIT`, and press Enter. Open the folder labeled `HKEY_LOCAL_MACHINE` by double-clicking on it or by clicking the plus sign next to the folder icon. Now open the `SOFTWARE`, `Microsoft`, `Windows`, and `CurrentVersion` folders, again by double-clicking or by clicking on the plus signs next to the folder icons. Then open the folder labeled `Uninstall`, and you'll see the items that show up in your uninstall list. Just delete the offending entries. Note that this doesn't remove the items from your `.INI` files. You'll still need to edit them to remove any changes made by programs you deleted.

CHRIS WOLSKI
Pearl City, Hawaii

PC MAGAZINE: When executed from the Add/Remove Programs applet found in Windows 95's Control Panel, the install program for a Windows 95 application will store instructions for removing that application from the system. This only happens when the program is installed via the Add/Remove Programs applet, and it also only happens when the install program cooperates. If at some later time you decide to remove the application, you bring up the Add/Remove Programs applet again and press the Add/Remove button. Some programs even let you add and remove individual features. But if you do choose to remove the application entirely, it

HIGHLIGHTS



HARDWARE Get your Windows 95 system to recognize Hewlett-Packard font cartridges using the HP Font Installer. *Page 404.*



OPERATING ENVIRONMENTS Reorder the items in your Windows 95 Start menu and submenus so that the programs and options you use most often are at the top. *Page 407.*



DATABASES Planning for the year 2000 in your FoxPro for Windows applications involves careful use of the `SET CENTURY` command. *Page 410.*

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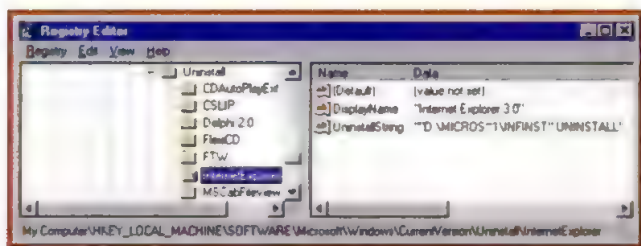


FIGURE 1: The list of uninstall programs used by the Add/Remove Programs applet is stored in the Registry.

disappears from the Add/Remove Programs list, as well as from your hard disk.

As this reader noted, the problem comes up when you simply blast an offending application from your disk without going through the Add/Remove Programs applet. You can't execute the uninstall program because the app is already gone, and thus the item never gets removed from the list. Most Windows 95 users probably have several phantom items in their Add/Remove Programs lists. The only way to sweep these remnants away completely is by using the Registry Editor.

In Figure 1, the uninstall entry for Microsoft Internet Explorer 3.0 is selected in the left-hand pane of the REGEDIT window. The DisplayName value in the right-hand pane is the value shown in the Add/Remove Programs list, and the UninstallString value is the command that will uninstall the application. With the key highlighted as shown, simply press Delete to remove that item from the Add/Remove programs list. Then shut down REGEDIT right away to avoid accidentally deleting something important.

More on the Windows 95 System Policy Editor

PC MAGAZINE: The July 1996 User-to-User column included a long discussion on using the Windows 95 System Policy Editor (Poledit.exe) to lock out unauthorized users and to control the access of authorized users. The Windows 95 CD-ROM contains Poledit.exe itself, as well as the example files Standard.pol and Maximum.pol; the technique described in the discussion relies on these example files. If you loaded Windows 95 from disks rather than from a CD-ROM, you can download PolEdit from www.microsoft.com or from the CompuServe MSWIN Forum. A number of readers, however, have pointed out that if you download the online version of PolEdit, you don't get the example policy files Maximum.pol and Standard.pol. Here's how you can create these files for yourself.

Start the System Policy Editor and choose

this keystroke works only with the asterisk key located on the numeric keypad. If your system doesn't have a separate asterisk key, you'll have to open every branch of the policy tree manually. Simply go down the list clicking on every boxed plus-sign until all branches are open.

Initially all of the policy check boxes will be grayed, and most of them can stay that way. You need to put a check in the specific boxes listed below and, in some cases, supply additional information in the lower panel of the Properties dialog.

- Control Panel | Printers | Restrict Printer Settings (in the lower panel, check only Disable Deletion of Printers)
- Shell | Custom Folders | Custom Programs Folder (in the lower panel, enter C:\Windows\Start Menu\Programs)
- Shell | Custom Folders | Custom Desktop Icons (in the lower panel, enter C:\Windows\Desktop)
- Shell | Custom Folders | Hide Start Menu subfolders
- Shell | Custom Folders | Custom Startup Folder (in the lower panel, enter C:\Windows\Start Menu\Programs\Startup)
- Shell | Custom Folders | Custom Network Neighborhood (in the lower panel, enter C:\Windows\Nethood)
- Shell | Custom Folders | Custom Start Menu (in the lower panel, enter C:\Windows\Start Menu)
- System | Restrictions | Disable Registry editing tools
- System | Restrictions | Disable MS-DOS prompt

Click OK to close the Properties dialog, then double-click on the Default Computer icon. Again, expand the policy tree completely either by pressing the Shift and asterisk keys together or by clicking on every boxed plus-sign icon. As before, all of the check boxes will be grayed to start with; you need to put a check by the following items:

- Network | Logon | Logon Banner (in the lower panel, enter "Important Notice;" and "Do not attempt to log on unless you are an authorized user")
- Network | Logon | Require validation by Network for Windows Access

New File from the File menu; icons will appear representing the Default User and Default Computer. Double-click on the Default User icon to edit the properties for Default User, then press the Shift and asterisk keys together to completely open the policy tree (Figure 2). Note that

- Network | Passwords | Hide shared passwords with asterisks
- Network | Passwords | Minimum Windows password length (in the lower panel enter the number 6)
- System | Enable User Profiles

Save the result as Standard.pol. Now choose Save As from the File menu and save it again as Maximum.pol. Maximum.pol is a more restrictive policy, so you must check a number of additional boxes. In the Default Computer properties, check:

- Network | Dial-Up Networking | Disable dial-in

In the Default User properties, check:

- Control Panel | Display | Restrict Display Control Panel (in the lower panel, check the box named Disable Display Control Panel)
- Control Panel | System | Restrict System Control Panel (in the lower panel, check all four boxes)
- Network | Sharing | Disable file sharing controls
- Network | Sharing | Disable print sharing controls
- Shell | Restrictions | Remove 'Run' command
- Shell | Restrictions | Remove folders from 'Settings' on Start Menu
- Shell | Restrictions | Remove Taskbar from 'Settings' on Start Menu
- Shell | Restrictions | No 'Entire Network' in Network Neighborhood
- Shell | Restrictions | No workgroup contents in Network Neighborhood
- Shell | Restrictions | Don't save settings at exit

Save Maximum.pol. Now you have the files referenced in the earlier article, and you can build your own security system using System Policy Editor.

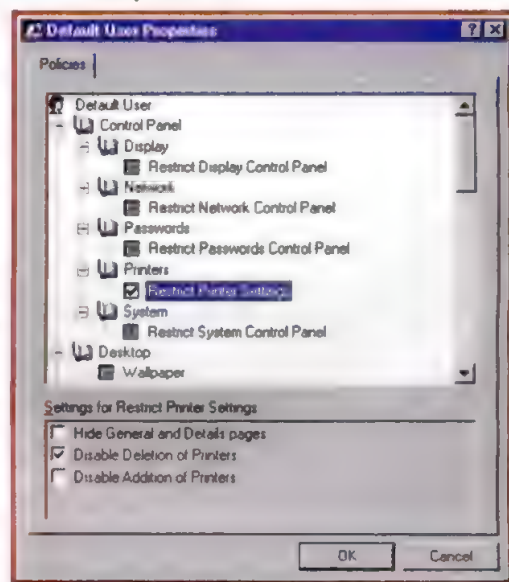


FIGURE 2: If you don't have the example files Maximum.pol and System.pol, you can create them yourself in the System Policy Editor.

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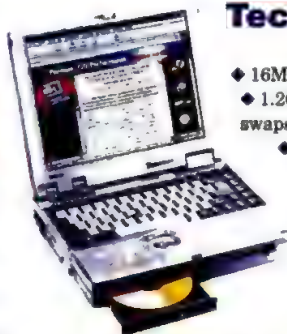
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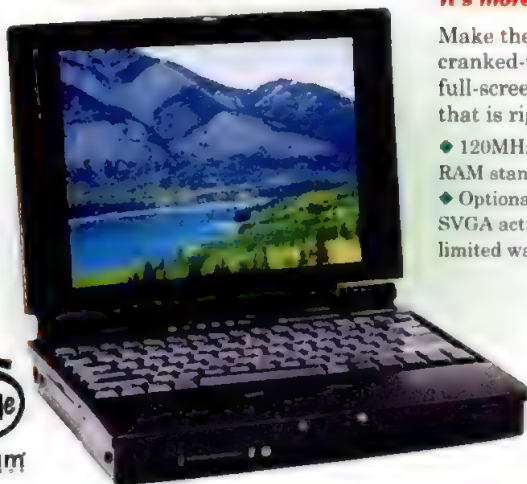
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Make the right notebook choice with NEC's Versa 6000 series. From cranked-up features like Intel Pentium® processing power to full-motion, full-screen MPEG video, these notebooks are the epitome of everything that is right about a desktop computer in a notebook form factor.

◆ 120MHz, 133MHz or 150MHz Intel Pentium® processor ◆ 8MB or 16MB EDO RAM standard, upgradeable to 72MB ◆ 1.08GB or 1.35GB hard disk drive
◆ Optional integrated 6X CD-ROM drive ◆ 11.3" (6020) or 12.1" (6030, 6050) SVGA active-matrix color display ◆ 28.8K bps PC Card modem ◆ 3-year limited warranty

6020 120MHz, 8MB, 1.08GB **\$4002.76** CDW 70835

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Extensa 600CD

◆ 120MHz Intel® Pentium® processor ◆ 8MB EDO RAM standard, 64MB maximum
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◆ Software: Microsoft® Windows® 95 with Microsoft Plus! or Windows for Workgroups V3.11
◆ Limited 1-year warranty

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CDW 75912

Extensa 650CD

◆ 133MHz Intel® Pentium® processor ◆ 16MB EDO RAM standard, 80MB maximum
◆ 1.4GB removable hard disk drive ◆ 1.44MB floppy disk drive ◆ 10X CD-ROM drive
◆ 12.1" DSTN dual-scan SVGA color display ◆ 16-bit stereo sound with two speakers
◆ Software: Microsoft® Windows® 95 with Microsoft Plus! or Windows for Workgroups V3.11
◆ Limited 1-year warranty

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CDW 75727

10X CD-ROM!

Extensa 650CDT

◆ 133MHz Intel® Pentium® processor ◆ 16MB EDO RAM standard, 80MB maximum
◆ 2.1GB removable hard disk drive ◆ 1.44MB floppy disk drive ◆ 10X CD-ROM drive
◆ 11.3" active-matrix SVGA color display ◆ 16-bit stereo sound with two speakers
◆ Software: Microsoft® Windows® 95 with Microsoft Plus! or Windows for Workgroups V3.11
◆ Limited 1-year warranty

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10X CD-ROM!



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Extraordinary value and performance

◆ 100MHz Intel Pentium® processor ◆ 8MB RAM standard, expandable to 40MB ◆ 810MB or 1.2GB removable hard disk drive ◆ Removable 6X CD-ROM and floppy disk drive ◆ 11.3" dual-scan (570CD) or 10.4" TFT active-matrix (570CDT) SVGA color display ◆ 6.4 lbs.

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CDW 67239

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CDW 67240

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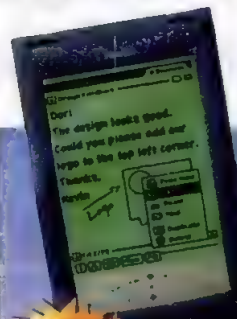
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WARRIOR TOOLS!



Apple® MessagePad® 130 With Newton® V2.0 Operating System

\$76.97
CDW 61340

The Apple® MessagePad® 130 has convenient user-controllable backlighting and a non-glare screen for easy viewing in any lighting condition. With additional system memory, the MessagePad 130 also offers improved multi-tasking support, as well as improved performance with Internet communications applications. The MessagePad 130 is powered by the Newton V2.0 operating system—the premier hand-held platform in the market today.

Win2Go allows business information to move between the MessagePad and a variety of Microsoft® Office for Windows 95 applications, allowing you to capture and access important information while on the go. It consists of several companion applications that connect to Microsoft Schedule+, Mail, Access, Word and PowerPoint, as well as an application that works as an information broker between the MessagePad and PC.

FREE
PICA'S Win2Go
software

Apple® Newton Keyboard

This touchtype comfortable keyboard is lightweight and portable and comes with an attractive carrying case, so you can take it wherever you take your Apple® MessagePad.



Apple® MessagePad® accessories

Newton Press	\$61.39	CDW 69432
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Rechargeable Battery Pack	\$19.21	CDW 39635
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AC power adapter	\$28.23	CDW 35952

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E-100D **\$1999.00** CDW 75127

E-133T **\$2999.00** CDW 75128



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■ 120MHz (M-120T) or 133MHz (M-133T) Intel® Pentium® processor ■ 16MB EDO RAM standard, expandable to 40MB ■ 1GB hard disk drive ■ 1.44MB floppy disk drive ■ Removable 4X (M-120T) or 6X (M-133T) CD-ROM drive ■ 11.8" active-matrix color display, slide hinge design ■ 28.8K bps PC Card data/fax/modem ■ PCI based 10BASE-T LAN port ■ Software: Microsoft® Windows® 95, Spry® Sprynet™, Netscape® Navigator™ V2.0, Symantec® Winfax® Lite, Lotus Organizer®, Artisoft® CoSession Remote™ and more! ■ 7.0 lbs. with CD-ROM and battery pack ■ 5-year limited warranty



M-120T **\$3699.00** CDW 75129

M-133T **\$4399.00** CDW 75131

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ThinkPad 365ED with CD-ROM

\$1899.00 CDW 68649

ThinkPad 365 Port Replicator/Charger

\$169.47 CDW 71099



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*Not just a new look,
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The Aptiva S Series features a breakthrough, space-saving design with a unique media console that allows easy access to the CD-ROM drive and floppy drive. This allows the mini-tower CPU to be placed up to six feet away—even under your desk!

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Aptiva S64 **\$2499.00** CDW 74046

Aptiva S66 **\$2649.00** CDW 74047

Aptiva S74 **\$2799.00** CDW 74048

Aptiva S78 **\$3099.00** CDW 74049



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- ✓ IrDA compliant
- ✓ Desktop personal scanner



9312

- ✓ DSVD 28.8K bps fax/data/voice modem
- ✓ Video conferencing software, TV tuner card and more!

9315/9316

- ✓ 3D graphics, 2MB video memory
- ✓ Joystick, stereo speakers w/subwoofer and more!



AST Advantage! Lifestyle mini-tower PCs

Model	CPU	RAM	Hard drive	CD-ROM	Price	CDW
9310	166MHz Pentium	24MB	2.5GB	8X	\$2499.00	71901
9312	166MHz Pentium	24MB	2.5GB	8X	\$2599.00	71902
9315	166MHz Pentium	32MB	2.5GB	8X	\$2699.00	71903
9316	200MHz Pentium	32MB	3GB	8X	\$2899.00	71905

AST Advantage! mini-tower PCs

Model	CPU	RAM	Hard drive	CD-ROM	Modem	Price	CDW
9304	133MHz Pentium	24MB	1.6GB	8X	33.6K bps	\$1699.00	71898
9208	166MHz Pentium	16MB	1.6GB	8X	33.6K bps	\$1899.00	75071
9308	166MHz Pentium	24MB	2.5GB	8X	33.6K bps	\$2199.00	71899
9314	200MHz Pentium	24MB	4GB	8X	33.6K bps	\$2699.00	71900

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Presario 4704

- ✓ 133MHz Intel® Pentium® processor
- ✓ RAM: 16MB EDO RAM standard, 128MB maximum
- ✓ 1.6GB hard disk drive
- ✓ Internal 6X CD-ROM drive
- ✓ 32-bit PCI accelerated graphics
- ✓ 1280 x 1024 maximum resolution
- ✓ JBL Pro stereo speakers
- ✓ 33.6K bps DSVD data/fax/voice modem
- ✓ Compaq keyboard and 2-button mouse
- ✓ Software included: Microsoft® Windows 95, Compaq Phone Center, Microsoft Works, CorelDRAW 5, and more!
- ✓ 1-year limited warranty



Monitor sold separately

Presario 4112

- ✓ 120MHz Intel® Pentium® processor
- ✓ 16MB EDO RAM standard, expandable to 72MB RAM
- ✓ 1.6GB hard disk drive
- ✓ Internal 6X CD-ROM drive
- ✓ Includes JBL Pro stereo speakers
- ✓ 33.6K bps DSVD data/fax/voice modem
- ✓ Software: Microsoft® Windows 95; Compaq Phone Center; Compton's Interactive Encyclopedia 96; Quicken Special Edition Multimedia; Microsoft Works; CorelDRAW 5 and more
- ✓ 1-year limited warranty



Monitor sold separately

\$1499.00 CDW 73385

Compaq Presarios

Desktop	CPU	RAM	Hard drive	CD-ROM	Price	CDW
4402*	133MHz Pentium	16MB	1.6GB	6X	\$1999.00	73388
4122	150MHz Pentium	16MB	2.5GB	8X	\$1899.00	73386
Mini-tower	CPU	RAM	Hard drive	CD-ROM	Price	CDW
4712	166MHz Pentium	24MB	2.5GB	6X	\$2199.00	73390
4716	200MHz Pentium	32MB	2.5GB	8X	\$2799.00	73391
6708	200MHz Pentium	32MB	2.5GB	8X	\$2999.00	73393
8702	166MHz Pentium	24MB	2.5GB	8X	\$2499.00	73394

*All-in-one design includes built-in 15" monitor

Presario 6704

- ✓ 166MHz Intel® Pentium® processor
- ✓ RAM: 24MB EDO RAM standard, 128MB maximum
- ✓ 2.5GB hard disk drive
- ✓ 1.44MB, 3.5" diskette drive
- ✓ Internal 8X CD-ROM drive
- ✓ 1280 x 1024 maximum resolution
- ✓ JBL Pro stereo speakers
- ✓ 33.6K bps DSVD data/fax/voice modem
- ✓ Compaq keyboard and 2-button mouse
- ✓ Software included: Microsoft® Windows 95, Word and PowerPoint; Lotus 1-2-3; Compaq Phone Center; CorelDRAW 5 and more!
- ✓ 1-year limited warranty

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The new Compaq Deskpro 2000, Deskpro 4000 and Deskpro 6000 product families set new standards for cost of ownership and serviceability in desktop personal computing for small, medium and large businesses. Compaq adds Intelligent Manageability to its entry level Deskpro 2000 line and includes new desktop manageability features to the Deskpro 4000 and Deskpro 6000 models—Inventory, Fault and Security Management—making Deskpros easier to inventory, troubleshoot, and protect. This second generation of Intelligent Manageability also offers a unique Smart Cover Sensor on the hood of the PC that alerts users and systems administrators of unauthorized access. The entire product line also comes equipped with significantly enhanced levels of serviceability that enables major components of the PC to be removed and replaced within five minutes or less. These include quick-release cover latches, a slide-out system board, and removable expansion board and hard drive cage.

Call for the Deskpro 6000 Series line-up!



Monitor sold separately

Compaq Deskpro 2000 series

Desktop	CPU	RAM	Hard drive	Price	CDW
5100/630	100MHz Pentium	8MB	630MB	\$1199.00	72604
5100/1200	100MHz Pentium	8MB	1.2GB	\$1289.00	72611
5100/1200	100MHz Pentium	16MB	1.2GB	\$1499.00	72754
5120/1200	120MHz Pentium	8MB	1.2GB	\$1299.00	72607
5120/1200	120MHz Pentium	16MB	1.2GB	\$1499.00	72612
5133/1200	133MHz Pentium	16MB	1.2GB	\$1599.00	72608
5133/2500	133MHz Pentium	16MB	2.5GB	\$1799.00	72613
5166/1200	166MHz Pentium	16MB	1.2GB	\$1899.00	72610
5166/2500	166MHz Pentium	16MB	2.5GB	\$2169.00	72614
5200/2500	200MHz Pentium	32MB	2.5GB	\$2769.00	72755
6180/1200/CD	180MHz Pentium Pro	16MB	1.2GB	\$2549.00	72756
6200/2500/CD	200MHz Pentium Pro	16MB	2.5GB	\$3159.00	72762

Mini-tower configurations also available.

Compaq Deskpro 4000 series

Desktop	CPU	RAM	Hard drive	Price	CDW
5120/1080	120MHz Pentium	16MB	1.08GB	\$1799.00	72691
5120/1620/LS	120MHz Pentium	16MB	1.62GB	\$1879.00	72692
5133/1080	133MHz Pentium	16MB	1.08GB	\$1809.00	72766
5133/1620	133MHz Pentium	16MB	1.62GB	\$1879.00	72768
5166/1620	166MHz Pentium	16MB	1.62GB	\$2099.00	72770
5166/2500/LS	166MHz Pentium	16MB	2.5GB	\$2399.00	72773
6180/1620/CDS	180MHz Pentium Pro	32MB	1.62GB	\$2799.00	72778
6200/2500/LS/CDS	200MHz Pentium Pro	32MB	2.5GB	\$3299.00	72779

Mini-tower configurations also available.

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Mini-tower	CPU	RAM	Hard drive	CD-ROM	Price	CDW
525MCx	133MHz Pentium	16MB	1.2GB	8X	\$1905.72	76405
525CD	166MHz Pentium	16MB	1.6GB	8X	\$2071.12	76406

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Hewlett Packard Vectra 500 Series PCs

Desktop	CPU	RAM	Hard drive	CD-ROM	Price	CDW
520MCx	120MHz Pentium	12MB	1.2GB	8X	\$1533.75	76395
520	133MHz Pentium	16MB	1.2GB	—	\$1279.84	76397
520CD	133MHz Pentium	16MB	1.2GB	8X	\$1534.65	76398
520MCx	133MHz Pentium	16MB	1.2GB	8X	\$1717.86	76399
Mini-tower	CPU	RAM	Hard drive	CD-ROM	Price	CDW
525CD	166MHz Pentium	16MB	1.6GB	8X	\$1894.94	76401
525MCx	166MHz Pentium	16MB	1.6GB	8X	\$2094.49	76400
525CD	200MHz Pentium	16MB	2.5GB	8X	\$2196.31	76402
525MCx	200MHz Pentium	32MB	2.5GB	8X	\$2584.40	76403

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32MB	\$442.39	74918	
DeskPro 2000, 4000, 6000			
8MB	\$78.94	74185	16MB \$143.46 74186
32MB	\$342.81	74187	64MB \$469.16 74188
LTE Elite 5000 series			
8MB	\$119.06	62465	16MB \$231.53 62466
32MB	\$423.95	62467	64MB \$663.51 62468
ProLiant 5000, 5000R			
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256MB	\$3509.06	71877	512MB \$24139.06 71878
Presario 962, 9536, 9548, 9549, 972, 962, 978, 974, 992			
8MB	\$78.01	54679	16MB \$154.65 54680
32MB	\$299.90	54682	64MB \$541.04 54681
Presario 7200 series			
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32MB	\$298.80	68813	64MB \$467.44 68814
ProLiant F75, P90			
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32MB	\$299.90	54682	64MB \$541.04 54681
ProSignia 500, 566			
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32MB	\$354.56	43170	64MB \$653.88 50828

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8MB	\$147.82	35181
32MB	\$415.88	43310
ThinkPad 756 series		
8MB	\$147.82	35181
32MB	\$421.23	43310
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16MB	\$213.27	62189

NEC

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32MB	\$513.71	71584
Versa 2000 series		
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8MB	\$148.93	61115	16MB \$252.13 61116
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Satellite Pro 400, 410 series			
8MB	\$146.21	63086	16MB \$246.56 63087
32MB	\$474.55	67894	
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4MB	\$67.51	52810	8MB \$118.63 52811
16MB	\$217.48	52812	24MB \$312.11 52813

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Tecra 500	16MB	\$199.87	73603
Tecra 500	32MB	\$381.36	74238
Tecra 500	48MB	\$581.49	73608
Tecra 500	128MB	\$4202.26	73610
Tecra 700	8MB	\$129.31	63615
Tecra 700	16MB	\$199.87	63616
Tecra 700	32MB	\$414.06	63618
T2150, T2100	4MB	\$61.27	54543
T2150, T2100	8MB	\$105.07	54544
T2150, T2100	16MB	\$206.30	54545
T2150, T2100	24MB	\$289.99	59659
T1900-1960	8MB	\$82.96	31222
T4500-4850	8MB	\$133.27	60303
T4500-4850	16MB	\$225.31	50394
T4900	16MB	\$271.45	57683
Portage 650CT	8MB	\$117.81	73602
Portage 650CT	16MB	\$199.87	73603
Portage 650CT	32MB	\$1105.76	73604
Portage 650CT	48MB	\$581.49	73608

TEXAS INSTRUMENTS

Ti5000, 5100	8-16MB Board	\$139.06	57534
Ti5000, 5100	16-24MB Board	\$244.30	57927
Ti5000, 5100	8MB	\$183.19	57928

NEC

Versa 4000 E, M, P, V	4MB	\$71.89	58253
Versa 4000 E, M, P, V	16MB	\$203.58	59564
Versa 4000 E, M, P, V	32MB	\$412.74	59565
Versa 6000	8MB	\$129.31	73594
Versa 6000	16MB	\$238.87	73595
Versa 6000	32MB	\$421.74	73596

IBM

Thinkpad 760	8MB	\$207.68	64562
Thinkpad 760	16MB	\$203.58	64563
Thinkpad 750, 755	4MB	\$85.36	46236
Thinkpad 750, 755	8MB	\$127.19	41041
Thinkpad 750, 755	16MB	\$247.03	43496
Thinkpad 750, 755	32MB	\$407.44	59478
Thinkpad 760E	8MB	\$127.19	69720
Thinkpad 760E	16MB	\$207.65	69721
Thinkpad 760E	32MB	\$875.82	73753
PC 300/700 Pentium	8MB	\$66.85	65267
PC 300/700 Pentium	16MB	\$159.47	65268
PC 300/700 Pentium	32MB	\$268.80	65269

Canon

Canon Innova Book 150c	4MB	\$159.13	59272
Canon Innova Book 150c	16MB	\$491.90	59273
Canon Innova Book 200LS	4MB	\$127.83	68392

OKIDATA

Okidata OL400E, OL400EX Series			
1-4MB Board		\$89.66	59595
2-4MB Board		\$109.60	59596
4MB Board		\$191.74	42084

AST

Ascenta A	8MB	\$131.90	69645
Ascenta J	8MB kit (2)	\$113.36	68376
Ascenta J	16MB kit (2)	\$182.23	68377
Ascenta J	32MB kit (2)	\$356.19	70209
Ascenta P	8MB	\$131.90	69645
Ascenta P	16MB	\$217.16	69646
Ascenta P	32MB	\$464.31	69647
Ascenta 900N, 910N	8MB	\$129.80	45233
Ascenta 950N	8MB	\$117.51	62104
Ascenta 950N	16MB	\$223.94	62107
Advantage Adventure 4000, 5000	16MB	\$164.54	48308
AST Bravo MS and MT P/90	8MB	\$75.27	48307
AST Bravo MS and MT P/90	16MB	\$129.68	58854
AST Bravo MS and MT P/90	32MB	\$336.99	44034

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Armada 1100	8MB	\$113.36	73588
Armada 1100	16MB	\$214.45	73589
Armada 1100	32MB	\$391.56	75794
Armada 4100	8MB Kit	\$119.28	73585
Armada 4100	16MB Kit	\$214.45	73589
Armada 4100	32MB Kit	\$352.23	73587
Contura 400, 420, 430	4MB	\$66.85	48781
Contura 400, 420, 430	8MB	\$103.68	51306
Contura 400, 420, 430	16MB	\$234.80	59300
Deskpro 2000/4000/6000	8MB	\$78.79	73038
Deskpro 2000/4000/6000	16MB	\$142.78	73039
Deskpro 2000/4000/6000	32MB	\$312.60	73040
Deskpro 2000/4000/6000	64MB	\$618.49	73041
LTE 5000 Series	8MB Kit	\$105.07	61396
LTE 5000 Series	16MB Kit	\$203.58	61397
LTE 5000 Series	32MB Kit	\$379.03	61398
LTE 5000 Series	64MB Kit	\$654.01	61399
Prolinea E, Pentium MX	4MB*	\$37.60	52826
Prolinea E, Pentium MX	8MB*	\$68.07	52827
Prolinea E, Pentium MX	16MB*	\$165.10	52829
Prolinea E, Pentium MX	32MB*	\$258.84	52830
* Must be installed in pairs			
Presario	4MB	\$39.00	58296
Presario	8MB	\$71.89	58297
Presario	16MB	\$137.34	53009
Presario	32MB	\$321.78	58298

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HP Laserjet 4 Plus, SP, 5MP	4MB	\$36.21	41038
HP Laserjet 4 Plus, SP, 5MP	8MB	\$67.73	41037
HP Laserjet 4 Plus, SP, 5MP	16MB	\$148.59	57009
HP Laserjet SL	2MB	\$59.88	65036
HP Laserjet SL	4MB	\$87.09	65037
HP Laserjet SL	8MB	\$124.42	64267
HP Laserjet 4, 4si	2MB	\$41.78	30100
HP Laserjet 4, 4si	4MB	\$61.82	30098
HP Laserjet 4, 4si	8MB	\$96.77	30099
HP VL4	4MB	\$39.38	63442
HP VL4	8MB	\$74.66	63443
HP VL4	16MB	\$164.84	63444
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Display size	14"	15"	17"	17"	17"
Viewable image size	13.4"	13.8"	15.8"	15.8"	15.8"
Dot pitch	.28mm	.28mm	.28mm	.26mm	.26mm
Max. resolution (non interlaced)	1024 x 768	1280 x 1024	1280 x 1024	1280 x 1024	1600 x 1200
Refresh rate	1024 x 768 @ 60Hz, 800 x 600 @ 75Hz	1280 x 1024 @ 60Hz, 1024 x 768 @ 75Hz	1280 x 1024 @ 60Hz, 1024 x 768 @ 75Hz	1080 x 1024 @ 65Hz, 1024 x 768 @ 75Hz	1600 x 1200 @ 75Hz, 1280 x 1024 @ 85Hz
CDW price	\$239.78	\$297.23	\$546.07	\$589.26	\$691.99
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new



P810

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Viewable image size	20"	20"	20"
Dot pitch	0.25mm	0.25mm	0.25mm
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Refresh rate	1280 x 1024 @ 83Hz	1280 x 1024 @ 88Hz	1600 x 1200 @ 91Hz
Special applications	page layout, CAD/CAM	CAD/CAM/CAE, image processing, desktop publishing	high-end graphics, production, science and engineering
CDW price	\$1424.69	\$1472.58	\$1642.01
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- ♦ Caller ID
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- ♦ V.42bis and MNP 5 data compression
- ♦ 7 LED status lights, external volume control
- ♦ Includes fax and data software
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External **\$149.29*** CDW 45114

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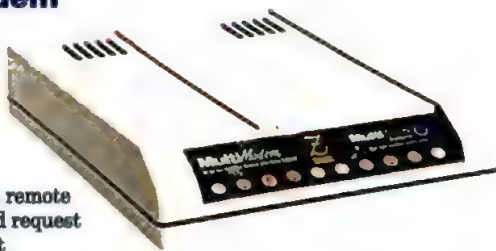


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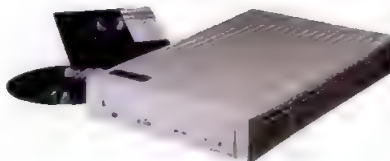
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backpack 4X External parallel port CD-ROM drive **\$219.67** CDW 49826

backpack 4X External parallel port CD-ROM drive with sound **\$307.76** CDW 55848



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- ✓ Easy to install, plugs into printer port
- ✓ Optical storage cartridge
- ✓ Data security: 30 years plus shelf life
- ✓ Can be used with multiple PCs

\$549.75 CDW 70962

backpack 800TD 800MB portable tape drive

- ✓ Maximum capacity: 390MB uncompressed, 800MB compressed with 3M Travan TR-1 data cartridges
- ✓ Also accepts QIC-Wide, EC or any QIC-80 tape cartridge
- ✓ Recording format: QIC-80
- ✓ Interfaces: standard parallel, enhanced parallel ports (EPP) and IEEE 1284 ports
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- ✓ Printer pass-through, detachable data cable
- ✓ Includes Windows 95, Windows and DOS backup software
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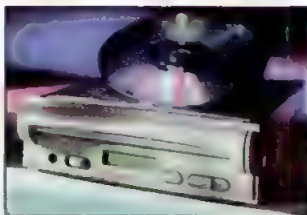
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- ◆ Includes cables, Windows 3.1 software disk
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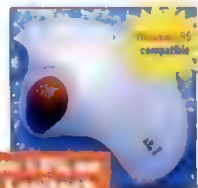
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Canon's MultiPASS C2500 is a state-of-the-art Color Bubble Jet™ printer that offers built-in fully-featured plain paper faxing, convenience copying and scanning to complete a home office.



Bubble Jet™ printer

■ 720 x 360 dpi ■ 5 ppm print speed in black and white ■ 0.3 to 0.8 ppm in color ■ 150 sheet paper capacity ■ Supports envelopes, transparencies, fabric sheets, T-shirt transfers

Plain paper fax

■ Maximum resolution: 203 x 196 fine print, 203 x 96 standard, UHQ and 64 shades of gray ■ 6 seconds per page print speed ■ 42 page print memory

Copier

■ Up to 99 copies ■ 360 dpi resolution with smoothing

Scanner

■ Resolution: 200 dpi ■ Software included: Desktop Manager V1.3, Canon Creative V2.0 CD-ROMs ■ 2-year InstantExchange warranty program

\$599.00 CDW 61252

Canon® BJC-4550 Color Bubble Jet™ printer

**Great big color for
Mac or PC**

For small or large tasks, the Canon® BJC-4550 is an outstanding value. Everything to meet the needs of a small business with big ideas has been considered, including the compact, space-saving size, and the convenience of dual interfaces for Macintosh® and PC.

■ 720 x 360 dpi resolution in color on plain paper, 720 x 360 dpi with smoothing in black and white ■ Maximum print speed: 1 ppm high quality color; 5 ppm high speed black and white ■ 300+ TrueType™ fonts on CD-ROM, 7 resident bitmap ■ 100 sheet built-in sheet feeder ■ Paper sizes: letter, legal, A4, #10 or European envelopes, A5, B5, 11" x 17" ■ Software: Canon Creative V2.0 CD-ROMs—create brochures, labels, business cards, flyers, picture frames, T-shirts and more ■ 1-year InstantExchange warranty program

new



Wide carriage 11"x17"

\$499.00 CDW 72598

BJC-620 Color Bubble Jet™ printer

**The ultimate
in color printing**

■ 720 x 720 dpi ■ 1.7 ppm color print speed ■ 3 ppm black and white print speed ■ 300+ TrueType™ fonts on CD-ROM, 7 resident bitmap fonts ■ Canon Creative V2.0 CD-ROMs—offer easy-to-use tools to help make small and home businesses look professional ■ Microsoft® Windows® Printing system ■ 1-year InstantExchange warranty program

new



\$399.00 CDW 72597

BJC-240 Color Bubble Jet™ printer

**Amazing color for
everything you do**

■ 360 x 360 dpi color ■ 0.27 ppm color print speed ■ 4 ppm black and white print speed ■ 300+ TrueType™ fonts, 7 resident bitmap fonts ■ Canon Creative V2.0 CD-ROMs—create brochures, labels, business cards, flyers, picture frames, T-shirts and more ■ Color Advisor V2.0, Visual Guide, Super Solver software ■ 1-year InstantExchange warranty program

new



\$179.00 CDW 72589

BC-06	\$34.13	CDW 72600
◆ Photo ink cartridge for BJC-240		
BC-22	\$39.43	CDW 72605
◆ Photo ink cartridge for BJC-4200 and BJC-4550		
BC-09F	\$34.13	CDW 72603
◆ Neon ink cartridge for BJC-200 series		
BC-29F	\$39.95	CDW 72609
◆ Neon ink cartridge for use with BJC-4000 series		

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800-326-4239

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FREE!

Software bundle with Stylus Color 500, Stylus 1500 and Stylus Pro inkjet printers

LOOK YOUR BEST COLOR PAK V2.0

Includes: ▼ Full version of Sierra Print Artist™ V3.0 and Adobe® PhotoDeluxe™ for PC ▼ FUNTASTIC Fonts, Outrageous Iron-on Art and Fab Photos ▼ Jump Start Guide, Color Tips booklet, valuable coupons for Epson products and more!

Offer valid through 1/31/97.



EPSON Stylus Color 500

Award-winning Photo Quality color printing for today's office

- ▼ Up to 4 ppm black text (360 x 360 dpi) ▼ ESC/P 2 and IBM® X24/X24E emulation
- ▼ Prints brilliantly on any type of paper ▼ Compatible with all Windows®, TrueType™ and Adobe® fonts ▼ Paper sizes: letter, legal, A4, B5, statement, executive, user definable ▼ IEEE-1284 parallel, serial connectivity
- ▼ 2-year limited warranty

\$279.00

CDW 73069

EPSON Stylus Pro

The next step in color inkjet printers

▼ Maximum resolution: 720 x 720 dpi in black or color on plain paper with Microdot technology

▼ Maximum print speed: 3 ppm black printing, 1 ppm color printing ▼ Paper sizes: letter, legal, A4, B5, statement, executive ▼ Parallel and serial interfaces ▼ PC and Macintosh compatible

▼ Networkable—optional Ethernet or LocalTalk interface cards available ▼ 2-year limited warranty



\$379.00

CDW 17100

EPSON Stylus 1500

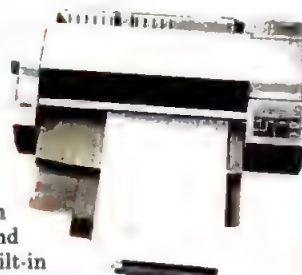
The perfect color inkjet printer for a variety of needs

The Epson Stylus 1500 accepts continuous and single sheet paper simultaneously, making printing on envelopes, labels, transparencies and paper stock a breeze. Adjust the built-in feeder to handle everything from 4" x 4" index cards to C-size (17" x 22") paper stock.

- ▼ Up to 720 x 720 dpi ▼ 4-color photographic printing with true laser quality black ▼ 400 cps (characters per second) draft mode ▼ 200 cps letter quality mode ▼ 100 sheet paper tray capacity ▼ Tractor included ▼ Bi-directional parallel interface ▼ 2-year limited warranty

\$995.00

CDW 66369



EPSON DOT MATRIX PRINTERS

Model	Carriage width	Pins	Features	CPS HS draft	CPS draft/utility	CPS NLQ	CPS LQ	CDW price	CDW
LX-300	normal	9	Optional color		284	53		\$165.41	39520
FX-870	normal	9	Handles 4-part forms	380	342	68		\$289.45	24886
FX-2170	wide	9	Handles 6-part forms	440	396	79		\$499.00	62768
LQ-2070	wide	24	8 built-in bar codes; extended ribbon life	300	275		92	\$383.04	73073
LQ-2170+	wide	24	Handles 5-part forms	440	396		132	\$599.00	62773
DFX-8000+	wide	9	Dual paper paths	560	504	101		\$1387.25	38206

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NAMES YOU KNOW,

2050

Color Jetprinter Thermal ink jet printer

**Inkjet affordability
and laser quality performance**

Lexmark includes their exclusive Workshop CD-ROM software with every 2050. Now you can design your own greeting cards, labels and certificates, manipulate images from Photo CDs or downloaded from the Internet, and even create your own comic books with just a click of your mouse.

- Up to 600 x 600 dpi edge sharpness in black and color
- Up to 5 ppm black print speed
- Host-based Windows® fonts
- Paper sizes: letter, legal, A4, B5, envelopes, index cards, transparencies, iron-on T-shirt transfer sheets, heavy card stock for greeting cards
- High speed parallel interface (IEEE 1284 compliant cable required)
- Software: Lexmark Workshop CD-ROM—Monotype GreetingCardMaker™, Monotype CertificateMaker™, Monotype T-Shirt DesignMaker™, SoftKey® Labels Unlimited®, EarthLink Network TotalAccess™ and Comic Creator™
- Super Sharp Waterproof® black ink and vivid color cartridges
- Starter paper pack
- 1-year warranty, next business day exchange

2070 Color Jetprinter

- 600 x 600 dpi
- 7 ppm black draft quality, 5 ppm black letter quality

\$338.40 CDW 62066

1020 Color Jetprinter Thermal ink jet printer

**Sharp, colorful
printing for
home or office**

The Lexmark™ 1020 Color Jetprinter™ has what you're looking for in a color printer. Bright color and crisp text printing. Lexmark's patented inks and special imaging technology ensure great results, even on plain paper and transparencies. The Lexmark 1020 even comes with a high-yield, vivid color ink cartridge.

- 600 x 300 dpi edge sharpness using digital enhancement in both black and color
- 2-4 minutes per page color
- 3 ppm black draft quality
- Host-based Windows™ fonts
- Paper sizes: letter, legal, B5, A4, executive, A5 and custom 3" x 5" to 8 1/2" x 14.33"
- High-speed parallel interface, (IEEE 1284 compliant cable required)
- Lexmark Workshop CD-ROM—Monotype GreetingCardMaker™, Monotype CertificateMaker™, Monotype T-ShirtDesignMaker™, SoftKey® Labels Unlimited®, EarthLink Network Total Access™, and Comic Creator™
- Starter paper pack
- 2-year warranty

\$148.15 CDW 62065

LEXMARK

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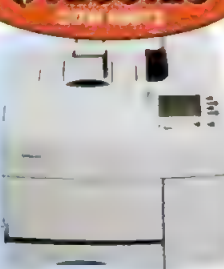
\$249.94 CDW 74303



Optra R+ Desktop laser printer

- 300 or 600 dpi, with PQET
- True 1200 x 1200 dpi, 8 ppm print speed
- 4MB RAM standard, 64MB maximum
- 25MHz AMD 29030 32-bit RISC CPU
- Emulations: Enhanced PCL 5, Postscript Level 2
- Concurrent (hot) interfaces: parallel, serial and 2 network interface ports
- Bi-directional communications Extended Capabilities Port (ECP) support
- Includes MarkVision Windows-based utility for network management
- Single element toner cartridge
- Heavy duty 35,000 page per month duty cycle
- 1-year LexExpress Warranty—next business day exchange via overnight delivery, optional on-site service available

\$1255.23



Optra Rt+ \$1483.44 CDW 69074
✓ 4MB RAM std. ✓ (2) 200 sheet paper trays

Optra Rn+ \$1483.44 CDW 69075
✓ 4MB RAM std. ✓ Ethernet 10BASE-T interface

Optra N 24 ppm laser printer

**The smart choice for
high-performance,
high quality printing**

- Up to 24 ppm
- 600 dpi
- 50MHz Intel i960 processor
- 4MB RAM standard, 64MB RAM maximum
- Enhanced PCL 5 emulation, PostScript Level 2
- Fonts: 114 scalable, 2 bitmapped
- Ports: high-speed serial, high-speed bi-directional parallel, two internal options ports
- Duty cycle: 100,000 pages per month maximum
- 1-year LexOnSite warranty



Optra N (Model 240) \$2688.22 CDW 69077

Optra N (Model 245) \$3288.66 CDW 69078
✓ 16MB RAM std. ✓ Ethernet 10BASE-T and 10BASE-2 interface

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- ◆ 600 dpi resolution
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- ◆ Standard parallel IEEE 1284 bi-directional interface
- ◆ Plug and Play (PnP) compatible
- ◆ 100 sheet auto-feeder paper input, 30 sheets paper output
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- ◆ 1-year limited warranty with Okidata Overnight Exchange
- ◆ 5-year limited warranty on LED printhead



\$299.00

CDW 70775

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Okidata OL600e

High resolution personal business printer

- ◆ 6 ppm print speed
- ◆ 600 dpi class output quality in Windows applications
- ◆ 300 dpi resolution with DOS applications
- ◆ 1MB RAM standard, 18MB maximum; Enhanced Memory Management
- ◆ 25MHz RISC microprocessor for fast print processing
- ◆ PCL 4.5 emulation, 44 bitmap fonts
- ◆ 100 sheet paper handling standard
- ◆ 5-year warranty on LED printhead, 1-year limited warranty on parts and labor



\$399.00

CDW 59207

OL610E

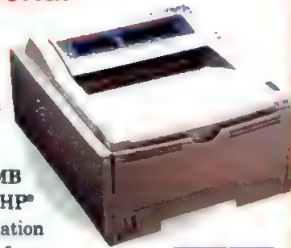
\$497.35

CDW 59208

Okidata OL810e

Fast, affordable and powerful

- ◆ 8 ppm print speed
- ◆ 600 x 1200 dpi maximum resolution
- ◆ 2MB RAM standard, 34MB maximum
- ◆ HP® PCL 5e emulation
- ◆ 45 resident fonts
- ◆ Interfaces: enhanced bi-directional parallel port and EPP serial port with auto-switching
- ◆ 250 sheet universal paper tray
- ◆ Low power consumption design, EPA Energy Star compliant
- ◆ Warranty: 5 years on LED printhead, 1-year parts and labor



\$673.62

CDW 55033

HP DeskJet 400 printer

Affordable, personal printer

- ◆ Resolution: 600 x 300 dpi black, 300 x 300 dpi color
- ◆ 3 minutes per page color
- ◆ 16KB RAM
- ◆ 48KB input buffer
- ◆ Emulation: HP PCL Level 3
- ◆ Fonts: Courier bitmap; GC Times and Letter Gothic (portrait only)
- ◆ Paper sizes: 7.35" x 10.5" to 8.5" x 14"
- ◆ Envelopes, transparencies and HP premium media
- ◆ 1-year limited warranty
- ◆ HP C2642A



\$204.61

CDW 72181

HP DeskJet 870Cse printer

Sharp text, flexible connections and brilliant color

- ◆ Resolution: 600 x 600 dpi black, 600 x 300 dpi C-RET color
- ◆ Best quality mode: 4 ppm black print speed, 1 ppm color print speed
- ◆ 20MHz RISC processor
- ◆ Memory: 512KB built-in RAM, 32KB receive buffer
- ◆ Emulation and fonts: HP PCL Level 3, 26 built-in scalable fonts, 27 TrueType fonts for Macintosh, 126 TrueType fonts for Windows
- ◆ Interfaces: RS-422 serial, AppleTalk® high-speed serial, Centronics parallel, IEEE 1284 compliant with 1284-B receptacle
- ◆ 1-year warranty
- ◆ HP C4565A



\$499.00

CDW 72326



HEWLETT® PACKARD

HP LaserJet 5L Xtra printer

Ultimate professional personal printing

- ◆ 600 x 600 dpi
- ◆ 4ppm print speed
- ◆ Emulation: Enhanced HP PCL 5, with 26 TrueType scalable fonts
- ◆ Memory: 1MB standard, 9MB maximum
- ◆ Prints on letter, legal, A4, A5, executive, envelopes, transparencies, card stock, postcards and labels
- ◆ 1-year warranty
- ◆ HP C3941C



\$429.00

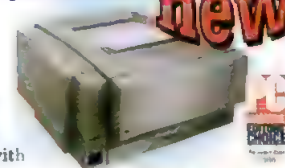
CDW 71446

*After \$50 mail-in manufacturer's rebate. Offer valid through 12/31/96.

HP LaserJet 6P printer

Full-featured laser printer for business

- ◆ Resolution: true 600 x 600 dpi laser
- ◆ 8 ppm print speed
- ◆ Memory: 2MB RAM standard plus Memory Enhancement technology (MET)
- ◆ HP PCL 6, 45 scalable typefaces built-in with an additional 65 on disk for Windows®
- ◆ Letter, legal, transparencies, envelopes, labels and postcards
- ◆ 250-sheet universal cassette tray and 100-sheet multipurpose tray
- ◆ 1-year warranty with free HP Express Exchange overnight printer replacement



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CDW 74906

HP LaserJet 6MP printer.....**\$913.65** CDW 74908

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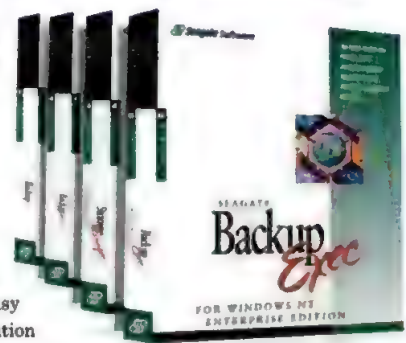


YOUR #1 NETWORK

Seagate Software

Backup Exec V6.11 for Windows NT

Seagate Backup Exec V6.11 for Windows NT is the field-proven, 100% compatible data protection solution for cross-platform, enterprise environments. It automates backup and restore functions with an integrated scheduling system for unattended operation. With its 32-bit performance and broad range of device support, Seagate Backup Exec V6.11 is fast and easy to use. And it's the only data solution that offers 100% Microsoft® BackOffice® support.



- ✓ Automates unattended scheduled backups for all servers and workstations
- ✓ Performs remote administration with Windows NT Remote Access Services (RAS) support
- ✓ Includes built-in STAC-LZS software data compression
- ✓ Runs multiple jobs simultaneously with multi-drive concurrent backup capabilities
- ✓ Offers both client and server support: DOS, all flavors of Windows, OS/2, NetWare V3.x and V4.x, Macintosh and UNIX
- ✓ Compatible with all devices supported by Windows NT
- ✓ Optional Autoloader, SNMP, Macintosh and UNIX support available

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Enterprise and Single Server Edition.....	\$822.15	CDW 73809
NetWare Agent.....	\$426.60	CDW 73813
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Autoloader Module	\$313.38	CDW 73811

Backup Exec V7.11 for NetWare

Seagate Backup Exec V7.11 for NetWare simplifies and automates enterprise data protection with an integrated scheduling system, while its Agent Accelerator technology maximizes backup performance. Backup Exec fully protects your NetWare, Windows NT and LAN servers as well as DOS, Windows, Windows 95, Windows NT, Macintosh, OS/2 and UNIX workstations-right out of the box. Selected as "Product of the Year" by LAN Magazine based on its high speed, broad functionality and overall performance, Seagate Backup Exec offers unmatched reliability for true enterprise-wide data protection.

- ✓ Novell-tested and approved for NetWare V3.0, V4.0 and V4.11
- ✓ Fully-automated for unattended backup
- ✓ STAC-LZS data compression and Agent Accelerator make Backup Exec the fastest backup solution
- ✓ Built-in support for Windows 95
- ✓ Manage up to 28 jobs simultaneously with concurrent job processing
- ✓ Exclusive SMART Client technology detects impending hardware failures on Windows 95 systems and automatically initiates a backup

Backup Exec V7.11 for NetWare	\$889.15	CDW 76531
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Backup for Windows 95

Seagate Backup for Windows 95, designed especially for Microsoft® Windows 95-based workstations, offers you complete data protection. Older DOS and Windows V3.x backup systems simply can't meet the demands of Windows 95 environments-leaving valuable data at risk. Backup for Windows 95 protects all your data, including long file names and the Registry database. Fully integrated with the OS to maximize performance, its 32-bit multi-threading and multi-tasking design enables you to complete backups faster than you ever thought possible.

- ✓ Eliminate installation headaches with totally automatic setup
- ✓ Transparently backup data while your computer is in use
- ✓ Perform unattended backup with user-defined scheduling flexibility in real-time, or off-peak hours

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Storage Manager V4.0 for NetWare and Windows NT

Storage Manager™ is the backup, archiving and integrated HSM software for growing networks. By using a single, integrated product you eliminate the problems of compatibility or synchronization of separate backup and storage management systems. You reduce the costs and ease administration since on-line, near-line and off-line data is managed from a single interface, with a shared tracking database, media library and hardware.

NetWare features

- ✓ Users can restore their own files without compromising network security or data integrity
- ✓ Effortlessly install Storage Manager with Seagate's built-in environment checker to review system settings and load necessary modules

Windows NT features

- ✓ Protects entire Windows NT network including NTFS, HPFS, VFAT, Macintosh, NT Registry and NTFS had links

Storage Manager for NetWare

Single server, 25 users	\$629.24	CDW 57087
Single server, unlimited users.....	\$1218.34	CDW 68773
Multiple servers, unlimited users	\$2322.16	CDW 55731

Storage Manager for Windows NT

Single server, unlimited users	1253.46	CDW 66774
Multiple server, unlimited users.....	\$2259.80	CDW 66775

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* Buy 3Com EtherLink III ISA TPO 5-pack (CDW 49028), and receive a FREE 3Com OfficeConnect TPO 8-port hub (CDW 66411) valued at \$150.00. Offer valid 10/1/96 - 11/30/96.

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OfficeConnect

**Compact, easy-to-use products that
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The OfficeConnect™ product line makes it simple for small offices to improve productivity by networking

their computer resources. A choice of three OfficeConnect hubs provide central connections for up to eight computers. Each of the three OfficeConnect Remote models permits high-speed connectivity to resources at different sites. The OfficeConnect Print and Fax Servers (supplied by Castelle*) allow sharing of printers and network fax services, respectively.



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Remote 520 ISDN and analog router	\$874.01	CDW 66620
Remote 530 WAN, ISDN and analog router	\$1008.99	CDW 66621
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▲ Guaranteed compatibility with leading notebooks or your money back within one year of purchase



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▼ Built-in modem sharing allows every PC on the network to share modems and phone lines as easily as they share printers ▼ Internet ready—includes the Netscape™ browser, SpryNet sign-on and an Internet dialer ▼ Artisoft's exclusive i-Share technology allows multiple users to share a single Internet connection ▼ LANtastic V7.0 allows "across the wire" installation, once you've loaded it into one machine you can do the rest across the network cable

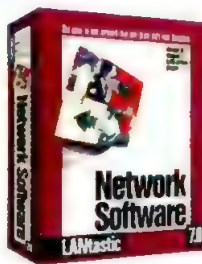
LANtastic V7.0

Starter kit, 3.5" and CD	\$245.54	CDW 70256
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Competitive upgrades

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Internet connectivity requires access services from an Internet access provider. Contact your local access provider(s) for rates, terms and conditions.



ModemShare V7.0 for Novell, Windows 95 and LANtastic networks

One modem, one phone line, one office

Artisoft® ModemShare™ offers businesses an easy, affordable way to share modems and phone lines across a local area network. With ModemShare, everyone on the network can use one modem and one phone line to share fax, Internet access programs.



- ▼ Shares up to 32 modems and phone lines in mixed Windows 95, Windows V3.x and DOS environments
- ▼ Virtually transparent—users access shared modems as if they had a local modem
- ▼ Redirects INT14 and NASI DOS communication packages to shared modems
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- ▼ Redirects COM ports to shared modems under Windows V3.x and Windows 95

1 shared port, unlimited users	\$87.91	CDW 66676
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CD.....\$29.73 CDW 75477
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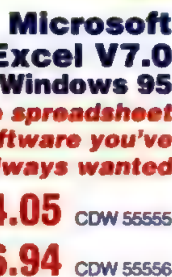
Microsoft Access V7.0 For Windows 95

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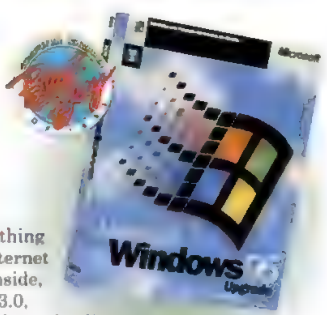


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Netelligent 2000 16-port 10BT repeater	553.34
Netelligent 5000 10/100BTX 6-port switch	1029.19
Netelligent 5012 10/100BTX 12-port switch	3114.08

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EtherExpress PRO/10+ PCI combo 5-pack	553.34
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NEC 8x8 8X CD internal SCSI-2	341.78
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TEXAS INSTRUMENT

Ask Our Advisors

HARDWARE

DeskJet Fonts for Windows 95



I have an HP DeskJet 500 with HP WordPerfect font cartridges. The cartridges worked perfectly under Windows 3.1, but I am having problems now that I've installed Windows 95 on my system. The Fonts screen under the Properties window for the DeskJet 500 driver in Windows 95 lists many font cartridges, but not the WordPerfect cartridges. And the Windows 3.1 driver install program for the printer won't run under Windows 95. Neither HP nor Microsoft could help me find a solution. Do you know if there is an updated printer driver I can get that will solve this problem?

TERRENCE RYAN
San Francisco, California

PC MAGAZINE: You won't find the WordPerfect font cartridges on the list of cartridges in the Windows 95 driver for the DeskJet 500, but you should be able to configure the driver to

add support for them. All you need to do is tell Windows about the fonts on each cartridge. This is not difficult to do, provided you have the necessary support file. This procedure works for both DeskJets and LaserJets—any printer that accepts a standard HP font cartridge.

All you need is a Printer Cartridge Metrics (.PCM) file, which should have been included with the font cartridge. This file contains all of the characteristics of the fonts on the cartridge, such as character width and spacing. Start by opening the printer's Properties window and choosing the Fonts tab. If the cartridge you wish to use is not on the list, choose the Install Printer Fonts option. This opens the HP Font Installer window, where you can choose the Add Fonts button. You will then be prompted for a drive location for the .PCM file. Select the desired cartridge and choose Add. (You'll need to provide a location for the driver support files.) When you exit the HP Font Installer, you'll find that the cartridge has been added to the list of supported cartridges. You can now select it, and you should be all set to print.

Note that the same can be done for individ-

ual fonts, such as downloadable fonts (often called soft fonts). For these, you'll need a Printer Font Metrics file (.PFM) in addition to the downloadable font file.—*Alfred Poor*

Removable Boot?

I need to create a complete backup of my hard disk that I can use as a boot disk in case of an emergency. Is it possible to use a CD-R (recordable CD)? If not, could I use some removable read/write media such as a PD/CD drive?

G. DUNCAN PETRIE
Orleans, Ontario, Canada

PC MAGAZINE: The idea of using a CD as a boot disk is a good one in general, although you may have to go with the read/write approach. All the CD-ROM drives I've seen require some sort of driver software to enable the computer to access the data on the CDs. You might have to create a floppy boot disk that would first load the required drivers, then complete the boot process from a CD-R in the CD-ROM drive.

The CD-R media is strictly write-once, so you'd have to burn a new disk each time you changed your hard disk configuration. If you used read/write media instead, you could simply update changed files.

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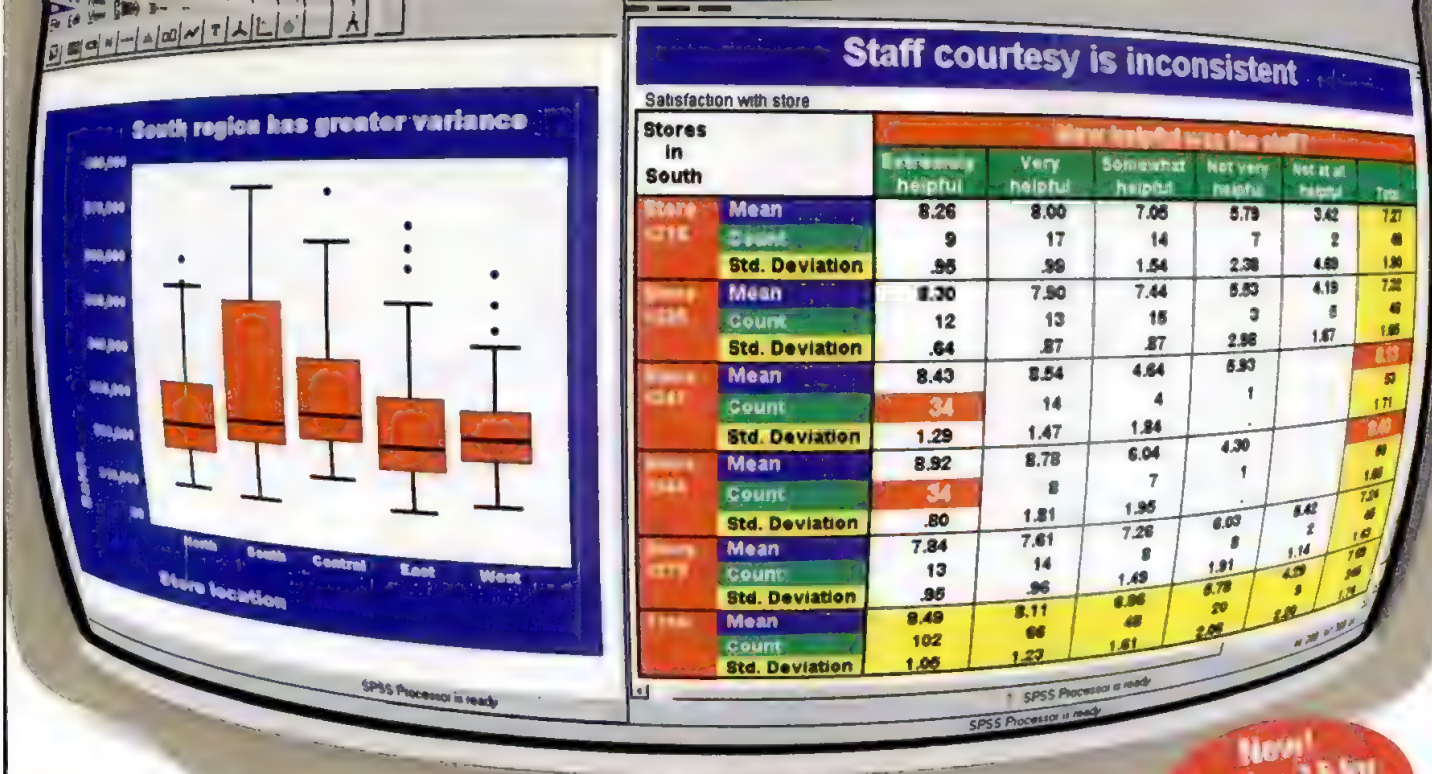
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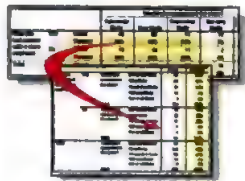
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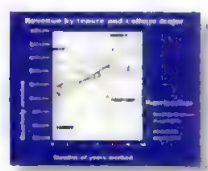
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If you use more than one operating system on a regular basis, there's another good reason to use a removable-media device as your boot drive. You can make a "clean" install of each operating system on separate disks and use your hard disk for shared applications and data (assuming that the file systems for the different operating systems are compatible). This can be useful if you have to support users who have different versions of Windows installed on their machines.—*Alfred Poor*

Giving the Registry The Slip

When I've installed some hardware devices under Windows 95, I've noticed that the resources used by some hardware devices, such as the I/O range assigned to my floppy disk drives, can vary depending on the order in which I install the devices. It appears that Windows 95 simply looks up entries in the Registry and verifies them in some cases, rather than looking for alternatives. Is there a way to run hardware auto-detection from scratch? How do you force Windows to ignore the Registry when looking for new hardware?

MICHAEL JUREK
Ridgefield Park, New Jersey

PC MAGAZINE: Most people don't think of it, but many programs have optional parameters and switches that can make a significant difference in what the programs do. All too often, these switches are poorly—if at all—documented in user manuals, but they can be handy to know about. One prime example of this is FDISK. Used alone, it runs the utility that lets you examine and change hard disk partitions. FDISK /MBR does something a bit different, however: It rebuilds the disk's Master Boot Record.

As it turns out, the Windows 95 Setup program has a wide range of switches that you can use to control what the program does and doesn't do. If you boot to DOS mode and then run the Windows 95 Setup program with a /? switch, you'll see a list of a number of switches that you can use with the Setup program. One that is not listed, however, is the /p switch. This option lets you pass instructions directly to the Detection Manager.

In order to skip the Registry during hardware auto-detection, the parameter you want for the /p switch is the "f" option. This is called the Clean Registry mode, and it causes the root branch of the Registry to be cleaned be-

fore the detection starts. This switch only works when you run SETUP from the DOS prompt; it does not work if the GUI portion of Windows 95 has already been started. To use this feature, you would give the following command at the DOS prompt:

SETUP /p f

Another handy option for Setup is the g=<n> parameter, where <n> is a number from 0 to 3. This controls how much information Detection gives as it does its work. The default setting is 0, which is total silence. At 3, the highest level, Detection will show all the resources used by devices that have been detected as well as showing a progress bar. If your computer is having a problem during the Detection process, this level will show you which devices have been loaded, as they are detected—possibly helping you determine which one is part of the problem. Use the command SETUP /p g=3 at the DOS prompt to set the Detection information level to its maximum.—*Alfred Poor*

OPERATING ENVIRONMENTS

Changing the Menu Item Order in Windows 95



Is there any way to alter the order of the content in the pop-up menus in Windows 95? I'd like to put the more frequently used components of certain menus in a more convenient order. Also, when your menus grow in size to include four or five submenus, Windows 95 starts exploding them to the left. This is obviously done to deal with the space requirements and to make certain the content is legible. But I'd prefer in certain cases that the menus continue to open to the right. Is there a way to alter how these menus open?

PAUL HOGUE
Marathon, Ontario, Canada

PC MAGAZINE: Windows 95 insists on sorting Start menu program menus. Submenus come first, in alphabetical order, followed by pro-

gram items, in alphabetical order. The simplest way to force a handful of items to the top of a menu is to rename them to begin with 1), 2), 3), and so on. Numbers come before letters in the sorting sequence, so these items will rise to the top of the list.

To rename items in the Start menu, right-click on the Start menu button and select Explore. Double-click on Programs, then navigate to the menu that contains the items you want to rename. Click twice slowly on an item name to enter editing mode, type the new name, and press Enter.

As for whether deeply nested submenus open to the right or left, that's out of our control. If you don't want to see submenus opening to the left, you'll have to change your menu structure. In some cases, one or more very long item names cause a particular menu to be extra wide; you can shrink these by giving the items shorter names. In other cases, there's no choice but to reduce the maximum submenu depth. Right-click on the Start menu button, select Explore, and rearrange the items and submenus just as you would files and directories. In point of fact, the items *are* files, and the submenus *are* directories—you'll find them all below the Start menu directory.

—*Neil J. Rubenking*

Windows for Workgroups on a 286?

I want to install Windows for Workgroups on my 286 computer, but after typing SETUP, I get a message saying Windows for Workgroups can only be installed on a 386 or higher machine. I determined that Windows 3.1 can be installed on a 286, but not Windows for Workgroups 3.11. What is causing the problem? Is it the workgroup software, or something else?

DAVID LIN
Temple City, California

PC MAGAZINE: Windows 3.0 supported the 8086 chip because it had Real-mode memory management, which Windows 3.1 dropped. In turn, Windows for Workgroups 3.11 dropped support for the 286 and its idiosyncratic protected-mode memory management. In both cases, users had to upgrade to a newer CPU or stick with the older Windows version. It's a simple matter of profitability: Microsoft has to balance the number of sales it'll lose by dropping support for the older processor with the expense of maintaining support for multiple processors and the profit expected by adding features that would not be possible while retaining support for the older processor.

In other words, there's no portion of Windows for Workgroups 3.11 that contains the source of the incompatibility with the 286. Rather, the specialized code that supported the 286 in Windows 3.1 has been removed

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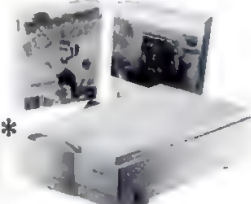
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throughout the operating system. So, alas, there is simply no way to run Windows for Workgroups 3.11 on a 286.

—Neil J. Rubenking

WORD PROCESSING

Merging Records by Phone Number



After creating a database in Lotus Word Pro with a single field for telephone numbers, I found I needed to run a merge with all of the entries with a given area code. At first, this seemed impossible, since the area code was not in a field of its own. A little experimenting, however, showed me that Word Pro's conditional merge feature can find entries for a given area code, even though the area code is not in a field of its own.

Suppose, for example, that the phone numbers are in a field called Phone, and you want to merge all of the records in the 215 area code. You can simply set the conditions to read:

```
If PHONE >= 215-000-0000
AND
If PHONE <= 215-999-9999
```

and you'll merge only those records with 215 area codes.

JULIE MCCOLLUM
Rosemont, Pennsylvania

PC MAGAZINE: Not only does this trick work as advertised, it even works if you have additional information in the field, such as an extension. In my tests, adding an x after the phone number along with some numerals didn't affect which records were selected. I also tried the format (215) 555-5555 without problems (using the same format for the numbers in both the data and the conditional statement). Presumably, other formats would also work, as long as you used the same format consistently in the data records.

A quick test with WordPerfect for Windows, Version 6.1, using the 215-555-5555 format showed that this technique will also work for WordPerfect, although WordPerfect will not include a phone number with an extension within the selection. The trick won't work with Microsoft Word, Versions 6.0 and 7.0, at all. Word apparently treats the phone number as a formula and computes the result before making the selection. Since 215-000-000 comes out to 215, while 215-999-9999 comes out to -10,783, Word complains that it can't find any data that is both greater than or equal to 215 and less than or equal to -10,783.

For those who aren't familiar with Word Pro's conditional merge feature, it's worth mentioning where to find it. After you create a data file and a merge document, choose Text |

Merge, go to the tabbed card labeled Step 3: View and Print, and choose the button labeled Limit To Selected Records to open the Merge Records dialog box. Select the Records Based On Field Conditions button, and Word Pro will show you three sets of fields for creating conditional statements. To use them, you simply fill in the blanks with the conditions Ms. McCollum describes.

—M. David Stone

SPREADSHEETS

Finding the Number of Days in a Month



Your issue of March 26, 1996, contains a tip for calculating the number of days in a given month in FoxPro. Coincidentally, I wrote an Excel formula to do this same thing just before reading about the FoxPro version. The FoxPro calculation involved some complicated jumps back and forth. In Excel, the task is much easier.

Because Excel's date functions allow out-of-range arguments, you can find the ending date of any month by asking for the zeroth date of the following month. Apply the DAY function to the end-of-month date, and you have the number of days in the month.

Assuming a date in A2, for example, the formula

```
=DAY(DATE(YEAR(A2),MONTH(A2)+1,0))
```

returns the number of days in A2's month.

Note that the DATE function can also handle a month argument greater than 12, so this formula works as well for December as for any other month. It also takes leap years into account.

GABRIEL SHAHAR
Tel Aviv, Israel

PC MAGAZINE: Excel's tolerance of out-of-range date arguments does simplify date arithmetic. The one place where the program falls short is in the year argument. Negative year arguments generate #NUM! Errors.

Interestingly, Quattro Pro accepts negative year arguments, returning negative serial date values. You can use these negative values to work with dates in the nineteenth century, should you have the need. But out-of-range arguments for months and days are rejected. On the other hand, Quattro Pro includes an @EMNTH function that returns the ending day of a month. Thus, getting the number of days in a month is even simpler in Quattro Pro than in Excel. Assuming the date is in A2, the formula

```
@DAY(@EMNTH(A2))
```

does the job.—Craig Stinson

DATABASES

Upgrading FoxPro Applications for the Year 2000



We needed a quick way to allow next-century date input for certain fields in a FoxPro 2.6 for Windows application. We would have liked simply to SET CENTURY ON systemwide, but that would mean regenerating several hundred screens to allow for the wider input.

We considered setting CENTURY ON in WHEN clauses and OFF in VALID clauses for selected date fields, but given the event-driven nature of the application, we were concerned we'd eventually find ourselves with CENTURY ON when and where we didn't want it. So we developed the set of functions shown in Figure 1 to provide absolute control over the CENTURY ON and OFF states as well as the flexibility to turn CENTURY ON at a later date without having to redo the CENTURY-handling we do now.

These functions work by using the STRTRAN function to pull forward slashes (//) out of a date that has been converted to a string. Then we use the "@R" picture mask to put the slashes back in on-screen. That way the slashes are fixed; they can't get pushed around and they don't get duplicated. We use the MONTH function with a CTOD function to make sure the input represents a real date.

To move a legacy application toward the year 2000, you need functions that control the CENTURY ON and OFF states.

MONTH will always return 0 for any invalid date. Finally, we use CTOD to convert the string back into a date.

We tested the functions in our production software running under FoxPro 2.6 for Windows.

GLENN JENNINGS
Houston, Texas

PC MAGAZINE: This is one approach to moving a legacy application in the direction of the year 2000. If you're starting a brand-new application, your best bet is to SET CENTURY

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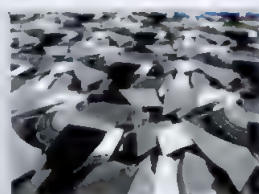
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```
*****
* Nextcent.prg                                FoxPro for Windows 2.6
* Demonstrate functions to allow next century input
*****
* Default Expiration Date
ld_expirdt = {1/1/2010}
lc_expirdt = l_date2str4( ld_expirdt ) && lc_expirdt is
=>"01012010"

* The picture and valid for the character get variable
@ 20.10 GET lc_expirdt PICTURE '@R 99/99/9999' VALID
=>v_str4date( lc_expirdt )
READ

* Convert the string date back into a real date
ld_expirdt = l_str2date4(lc_expirdt)
RETURN

*****
* FUNCTION l_date2str4
* Converts a date into an 8 character date string with no
* "/"
*****
FUNCTION l_date2str4
PARAMETERS pd_date
PRIVATE lc_return, lc_century
* Save current Century setting.
* Later, we can turn CENTURY ON
* permanently.
lc_century = SYS(2001,"CENTURY")
SET CENTURY ON
* Note: strtran pulls out the "/" characters.
* ie {3/4/96}=>"03041996"
```

```
lc_return = STRTRAN( DTOC(pd_date),"/","")
SET CENTURY &lc_century.
RETURN lc_return
```

```
*****
* FUNCTION v_str4date
* Validates date input into a strdate character variable.
*****
FUNCTION v_str4date
PARAMETER pc_datestr
PRIVATE ll_return
* Check to make sure there are 8 characters to work with
* and the 8 characters represent a real date.
ll_return = LEN(ALLTRIM(pc_datestr))=8 .and. ;
MONTH( CTOD( LEFT(pc_datestr,2) + "/" + ;
SUBSTR(pc_datestr,3,2) + "/" + ;
RIGHT(pc_datestr,4) ) ) <> 0
RETURN (ll_return)

*****
* FUNCTION l_str2date4
* Converts the 8 character date string back into
* a real date.
*****
FUNCTION l_str2date4
PARAMETERS pc_datestr
PRIVATE ld_return
ld_return = CTOD( LEFT(pc_datestr,2) + "/" + ;
SUBSTR(pc_datestr,3,2) + "/" + ;
RIGHT(pc_datestr,4) )
RETURN ld_return
```



FIGURE 1: The code shown above demonstrates how to incorporate next-century data input selectively into your FoxPro applications.

ON once and for all early in your application and then forget it. In FoxPro, the SET CENTURY command determines whether the year component in dates is two digits or four digits long. If it's two digits, as is the case when CENTURY is OFF, the year is currently assumed to begin with 19. So you could enter 12/31/01 and it would mean 12/31/1901. With SET CENTURY ON, you must enter all four digits for the year.

Of course, setting CENTURY ON can have dramatic consequences in an application that wasn't designed to accept four-digit year input. At the very least, screens with input fields would have to be redesigned, fields would have to be widened, and so on. The technique described here was designed to avoid such a major systemwide change in favor of the gradual adjustment of only those fields that require next-century input. Here's how it works:

- Convert the date to be edited into a string in the form mmddyyyy (the l_date2str4 function)
- Edit the string using @GET with PICTURE '@R 99/99/9999' to force entry of a full four-digit year.
- Use the VALID clause to validate the date

string entered (the v_str4date function).

- Convert the entered date string into a real date variable (the l_str2date4 function).

Because one of the goals is to avoid setting CENTURY ON and OFF in various places in your code, I'd recommend replacing the first function in Figure 1 with the following, which avoids using the SET CENTURY command:

```
FUNCTION l_date2str4
PARAMETERS pd_date
PRIVATE lc_return, lc_temp
lc_temp=DTOS(pd_date)
lc_return=SUBSTR(lc_temp,5,2) +
SUBSTR(lc_temp,7,2) +
LEFT(lc_temp,4)
RETURN lc_return
```

If you do use the code in Figure 1, you should remember to include a SET DATE AMERICAN command early in your application. If you don't, a curious user could change the international settings in Windows (which FoxPro adopts unless told otherwise). That would break the second and third functions in Figure 1, because they rely on the input string being in month-day-year order.

The code can be downloaded from PC Magazine Online. Look for NEXTCENT.PRG in the volume archive file, v15n21.zip.

—Sal Ricciardi

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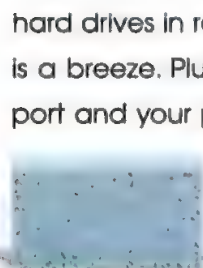
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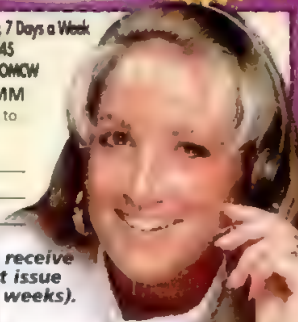
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500	Pentium 150	12.1" Active	16MB/1.3GB	4399*
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* Features built-in 28.8 fax modem



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Milan	Pentium 120	11.3" Active	8MB/1.2GB	3349*
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Monte Carlo	Pentium 120	11.3" Active	16MB/1GB	3849*
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Satellite Pro 420

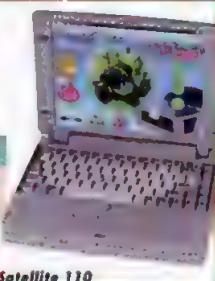
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- Built-in SoundBlaster Pro-compatible audio

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- Infrared port for wireless communications

Model	Processor	Display	RAM	Price
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365X	Pentium 120	10.4" Active	8/810MB	2499
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365XD	Pentium 133	11.3" Active	8MB/1.4GB	3499

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760E	Pentium 120	12.1" Active	8MB/1.2GB	\$4549
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760EL	Pentium 133	12.1" Active	16MB/1.0GB	5499
760ED	Pentium 133	12.1" Active	16MB/1.2GB	5399*

* Features built-in 4X CD-ROM drive Additional models available. Call for details



ThinkPad® 760

COMPAQ



Armada

Compaq Armada

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1120	Pentium 100	10.4" Dual Scan	8/810MB	\$1879
1120T	Pentium 100	10.4" Active	8/810MB	2199
4110	Pentium 100	11.3" Dual Scan	8/810MB	2479*
4110D	Pentium 100	11.3" Dual Scan	8/810MB	2899*
4120	Pentium 120	11.3" Dual Scan	16MB/1.1GB	2999*
4120T	Pentium 120	11.8" Active	16/810MB	3699*
4130T	Pentium 133	11.8" Active	16MB/1.1GB	4399*

* Features built-in audio

† Includes 4X CD-ROM drive

LTE 5000 Series

Model	Processor	Display	RAM	Price
5150	Pentium 100	11.3" Dual Scan	8/810MB	\$2849
5250	Pentium 120	10.4" Active	16/810MB	3599
5280	Pentium 120	11.3" Active	16MB/1.35GB	4349
5200	Pentium 120	10.4" Active	8MB/1.35GB	4720
5300	Pentium 133	12.1" Active	16MB/1.35GB	4749
5380	Pentium 133	12.1" Active	16MB/2.2GB	6299



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E133T	Pentium 133	11.3" Active	16/810MB		2999

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M100D	Pentium 100	11.3" Dual Scan	8/810MB		2099*
M120T	Pentium 120	11.8" Active	16MB/1GB		3699
M120T	Pentium 120	11.8" Active	16MB/1GB		3699*
M133T	Pentium 133	11.8" Active	16MB/1GB		4399
M133T	Pentium 133	11.8" Active	16MB/1GB		4399*

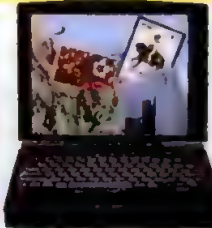
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Extensa 6000

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- 2MB video memory

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6030	Pentium 133	12.1" Active	16MB/1.35GB		4889
6050	Pentium 150	12.1" Active	16MB/1.35GB		5379

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TravelMate 6000

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- SoundBlaster compatible audio



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Sharp 3000 & 9000

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3040	Pentium 100	12.1" Dual Scan	8MB/1.1GB		\$1799
9000	Pentium 100	11.3" Dual Scan	8MB/1GB		2299†
9020	Pentium 120	12.1" Dual Scan	16MB/1.1GB		2899†
9030	Pentium 120	11.3" Active (SHA)	8MB/1.1GB		2949†
9050	Pentium 133	11.3" Active (SHA)	16MB/1.1GB		3499†
9070	Pentium 133	12.1" Active (SHA)	16MB/1GB		4149*
9080	Pentium 133	12.1" Active (SHA)	16MB/1.3GB		4999†

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- 64-bit PCI graphics with 2MB of video memory



Sharp
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Model	Processor	Display	RAM	HD	Price
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W100T	Pentium 133	11.2" Wide Active	16MB/1.1GB		3499

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- 24MB of RAM memory on selected models
- Built-in 28.8 fax/modem

Model	Processor	Screen	RAM/HD	Price
A41	Pentium 120	11.3" Dual Scan	16MB/1.0GB	\$2499
A42	Pentium 120	12.1" Active	16MB/1.0GB	3199
P50	Pentium 133	12.1" Active	24MB/1.0GB	3979*
P50	Pentium 133	12.1" Active	24MB/2.1GB	4349*

* Features built-in 28.8 fax/modem

AST Ascentia J

- Integrated fax/modem and audio on selected models
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Model	Processor	Screen	RAM/HD	Price
J10	Pentium 75	10.4" Dual Scan	8/500MB	\$1849
J20	Pentium 100	11.3" Dual Scan	8/810MB	1749
J10	Pentium 75	10.4" Dual Scan	8/800MB	1999
J30	Pentium 100	10.4" Dual Scan	8/800MB	2049
J30	Pentium 100	10.4" Active Matrix	8/800MB	2269
J50	Pentium 133	10.4" Active Matrix	8/800MB	2649



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5500CTS	Pentium 120	12.1" Active	16MB/1.35GB	4149
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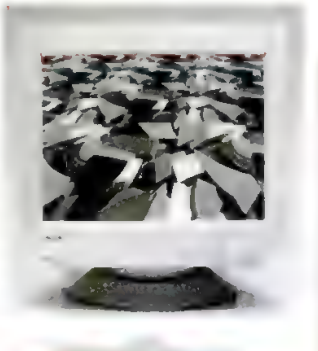
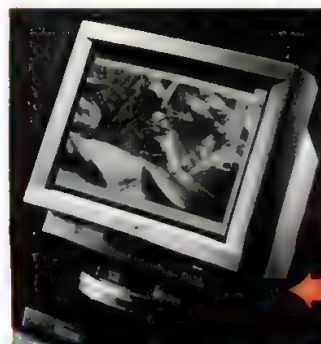
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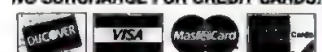
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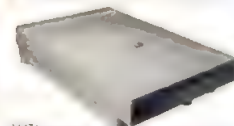
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4294MB	MC3243	\$795	\$855
4550MB	MC4345	\$999	\$1059
9091MB	MC3391	\$1799	\$1859
9100MB	MC1991	\$1585	\$1685
SCSI A/V			
2050MB	MC4221AV	\$600	\$660
4294MB	MC3243AV	\$885	\$945
9100MB	MC1991AV	\$1699	\$1799
Wide SCSI			
4294MB	MC3243W	\$885	\$1015
4550MB	MC4345W	\$1020	\$1130
9091MB	MC3391W	\$1709	\$1849
9100MB	MC1991W	\$1679	\$1869
Wide SCSI A/V			
4294MB	MC3243WAV	\$979	\$1109
9100MB	MC1991WAV	\$1839	\$2029
Wide Differential SCSI A/V			
4294MB	MC3243WD	\$899	\$1029

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#ST32140A

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Quantum

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IDE Hard Drive
#TM33200A

\$329

Seagate

1.6 Gig

IDE Hard Drive
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#M1638T

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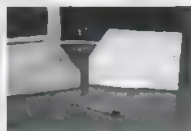
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3 Gig	\$599

CD ROM Drives

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6X	\$199
8X	\$249
10X	\$299

Smart Storage Solutions CD Towers



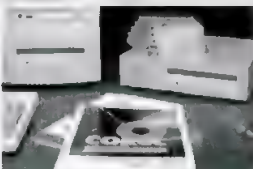
Allows access to multiple CDs at one time. Perfect for schools, BBS, etc. Budget Towers feature a 200w power supply, Epic Towers feature dual 65w power supplies. Listed are 4/7 drive towers - 2 to 21 drive towers are available.



NEC	4X	Budget \$659/\$1149	Epic \$759/\$1259
Plexor	6X	Budget \$1599/\$2789	Epic \$1699/\$2899
Philips	8X	Budget \$1359/\$2389	Epic \$1459/\$2499
PLexor	8X	Budget \$2199/\$3899	Epic \$2299/\$3999



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A1542CKIT, ISA, Floppy, Bus Master	\$249
A2920KIT, PCI, PIO	\$159
A2930, PCI, 32bit SCSI (Bus Master)	\$189
A2940, Bare, PCI, Bus Master	\$199
A2940KIT, PCI, Bus Master	\$259
A2940WKIT, PCI, Wide SCSI, Bus Master	\$299
A2940MUW, PCI, Wide SCSI, for Macintosh	\$325
A3940KIT, PCI, Twin Channel, Bus Master	\$419
A3940WKIT, PCI, Wide, Twin Channel, Bus Master	\$519
A3985KIT, PCI, RAID, Bus Master	\$719
A3985WKIT, PCI, Wide, RAID, Bus Master	\$819
A2842VLKIT, VESA, Floppy, Bus Master	\$239
A2825VLKIT, EIDE, SCSI, floppy	\$135

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TR4	[TR4]	\$41	\$36	\$34
QW3010	[QW3010]	\$30	\$25	\$23
QW3020	[QW3020]	\$30	\$25	\$23
QW3080	[QW3080]	\$32	\$27	\$25
4mm 90M	[DAT90M]	\$15	\$10	\$8
4mm 120M	[DAT120M]	\$27	\$22	\$20
8mm 112M	[DAT112M8MM]	\$15	\$10	\$8

OPTICAL DISKS

230MB	[TJ230]	\$21	\$16	\$14
650MB 1024K	[TJ650]	\$45	\$41	\$39
1.3GB 1024K	[TJ1.3]	\$51	\$47	\$45
2.6GB 1024K	[TJ2.6]	\$69	\$65	\$63

SYQUEST

88MB	[SQ800]	\$48	\$44	\$42
135MB	[EZDISK]	\$26	\$22	\$20
200MB	[SQ2000]	\$72	\$68	\$66
230MB	[EZ230C]	\$30	\$26	\$24
270MB	[SQ327]	\$58	\$54	\$52

NOMAI (SyQuest compatible)

44MB	[N450U]	\$34	\$30	\$28
88MB	[N900U]	\$38	\$34	\$32
200MB	[N200U]	\$62	\$58	\$56
270MB	[N270U]	\$52	\$48	\$46

IOmega

100MB ZIP	[ZIP100C]	\$23	\$18	\$16
1Gig JAZ	[JAZC-1GIG]	\$99	\$95	\$93

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230MB	Fujitsu IDE	\$339
230MB	Smart Storage Solutions SCSI	\$339
640MB	Smart Storage Solutions SCSI	\$539
640MB	Fujitsu (230MB backwards compatible)	\$555
650MB	PD ROM combination optical & 4XCD	\$399
1.3Gig	Maxoptix	\$1029
2.6Gig	Smart Storage Solutions	\$1649
2.6Gig	Maxoptix	\$1669
2.6Gig	Hewlett Packard	\$2215
52Gig	Maxoptix (does not include free disks)	\$4549

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Smart & Friendly	2X Write 4X Read	\$799
Teac	4X Write 4X Read	\$829
Smart Storage Solutions	4X Write 4X Read	\$905

• CD ROM DRIVES •

SCSI

Brand	Spin	Model	Speed	Int	Ext
NEC	4X	CDR222	200ms	\$99	\$189
Plextor	6X	PX63CS	145ms	\$269	\$359
Philips	8X	PC80S	195ms	\$205	\$295
NEC	8X	CDR1410	145ms	\$215	\$305
Plextor	8X	PX83CS	115ms	\$309	\$399

ATAPI IDE

Brand	Spin	Model	Speed	Int	Int kit
NEC	6X	CDR1300	145ms	\$89	\$104
Mitsumi	8X	CRMCFX800	150ms	\$110	\$125
Sony	8X	CDU311	160ms	\$115	\$130
Toshiba	8X	XM5602B	145ms	\$110	\$125
NEC	8X	CDR1400	140ms	\$110	\$125
New	10X	IDECD10X	180ms	\$129	\$144

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Mitsumi 12X	CRMCFX12X	150ms	\$195	\$210
OEM 12X	IDECD12X	150ms	\$155	\$170

IDE CD ROM CHANGER

NEC	4X	CDR4X4	4Disk	250ms	\$99
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SCSI CD ROM CHANGERS

Nakamichi	8X	MJ48S	4Disk	150ms	\$549
Pioneer	4.4X	DRM-624X	6 Disk	190ms	\$359

• TAPE DRIVES •

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Includes DOS/Win backup software and 1 free tape.

800MB	Seagate	TST800R	\$141
1Gig	Seagate	TST800PLUS	\$159
1.7Gig	Seagate	TSM1700	\$219
3.2Gig	Seagate	TST3200RFT	\$239

PRINTER PORT MINICARTRIDGE

Includes DOS/Win backup software and 1 free tape.

800MB	Seagate	TST800RPT	\$259
1Gig	Seagate	TST800PLUS	\$269

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4-8GB	Seagate	TST8000(A)	\$379
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SCSI 4mm DAT

2GB	Hewlett Packard	C1534	\$609
2-4GB	Seagate	C4324RP	\$679
2-4GB	Hewlett Packard	C1536	\$699
4-8GB	Sony	SDT5000	\$809
4-8GB	Seagate	C4326NP (DDS2)	\$859
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4-8GB	Sony	SDT7000	\$909
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7-14GB	Exabyte	EXB8700LT	\$1089
20-40GB	Exabyte	EXB8900	\$5499
70-140GB	Exabyte	EXB10H 10 tape autoloader	\$5439

SCSI DLT

15-30GB	Quantum	DLT2000	\$2499
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BACKUP SOFTWARE (SAVE \$10 with hard drive purchase)

NovaStor's NovaBack CD contains software for DOS, Win 3.1, Win 95, OS/2, Warp, and Macintosh	\$79
Seagate Arcadia for Windows NT (call for network version)	
workstation/single server/enterprise	\$239/499/869
TAPEDISK, allows DAT drive to be used as hard drive under DOS/Win 3.1, Win 95	\$189

• IDE HARD DRIVES •

IDE	Speed	RPM	Brand	Model	Wty	Price
540MB	14ms	3600	Seagate	ST3541A	3	\$139
631MB	14ms	3600	Seagate	ST3630A	3	\$145
850MB	10ms	4500	Western Digital	AC2850	3	\$165
850MB	14ms	3600	Seagate	ST3851A	3	\$155
1084MB	14ms	4480	Maxtor	M71084A	2	\$185
1200MB	10ms	5400	Fujitsu	M1636T	3	\$195
1250MB	15ms	3600	Quantum	BF1250A	3	\$175
1275MB	12ms	4500	Seagate	ST31276A	3	\$195
1280MB	11ms	4500	Quantum	TM31280A	3	\$195
1281MB	11ms	5200	Western Digital	AC21200A	3	\$199
1330MB	12ms	4480	Maxtor	M71336A	3	\$195
1623MB	14ms	3600	Seagate	ST31621A	3	\$212
1624MB	10ms	5200	Western Digital	AC21600	3	\$225
1670MB	11ms	4480	Maxtor	M71670A	3	\$215
1700MB	10ms	5400	Fujitsu	M1623T	3	\$219
1700MB	11ms	4500	Quantum	SR31700A	3	\$218
2004MB	11ms	4480	Maxtor	M72004A	3	\$255
2100MB	11ms	5200	Western Digital	AC22100	3	\$279
2100MB	9ms	5400	Fujitsu	M1624T	3	\$269
2167MB	10.5ms	5400	Seagate	ST32140A	3	\$269
2168MB	10.5ms	4500	Quantum	TM32160A	3	\$265
2500MB	9ms	5400	Fujitsu	M1638T	3	\$295
2550MB	15ms	3600	Quantum	BF2500A	3	\$249
2550MB	11ms	4500	Quantum	SR32550A	3	\$295
2559MB	11ms	5200	Western Digital	AC32500	3	\$299
2700MB	12ms	4480	Maxtor	M72700A	3	\$315
3166MB	12ms	5200	Western Digital	AC33100	3	\$369
3254MB	10.5ms	4500	Quantum	TM33200A	3	\$339
3500MB	12ms	4480	Maxtor	M83500A	3	\$429
3840MB	10.5ms	4500	Quantum	TM33840A	3	\$395
4250MB	10.5ms	5400	Seagate	ST34250A	3	\$Call

• SCSI HARD DRIVES •

SCSI	Speed	RPM	Brand	Model	Wty	Int	Ext
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1082MB	12ms	4500	Quantum	TM31080S	3	\$299	\$359
2110MB	10.5ms	4500	Quantum	TM32110S	3	\$379	\$439
2147MB	9ms	5400	Seagate	ST32155N	5	\$485	\$545
2147MB	8ms	7200	Seagate	ST32550N	5	\$729	\$789
2150MB	8.5ms	7200	Quantum	XP32150	5	\$629	\$689
3254MB	10.5ms	4500	Quantum	TM33200S	3	\$459	\$519
4290MB	8ms	7200	Seagate	ST15230N	5	\$885	\$945
4350MB	8ms	7200	Seagate	ST34371N	5	\$1155	\$1215
9080MB	11ms	5400	Seagate	ST410800N	5	\$1779	\$1879
9100MB	9ms	7200	Seagate	ST19171N	5	\$2095	\$2195

WIDE SCSI

1050MB	9ms	5400	Seagate	ST31055W	5	\$389	\$519
1070MB	8ms	7200	Quantum	XP31070W	5	\$299	\$429
2147MB	8ms	7200	Seagate	ST32550W	5	\$789	\$919
2150MB	9ms	5400	Seagate	ST32155W	5	\$559	\$689
2150MB	8.5ms	7200	Quantum	XP32150W	5	\$649	\$779
4294MB	8ms	7200	Seagate	ST15150W	5	\$1029	\$1159
4300MB	8.6ms	7200	Quantum	XP34300W	5	\$919	\$1049
4350MB	8ms	7200	Seagate	ST34371W	5	\$1199	\$1389
9100MB	11ms	5400	Seagate	ST410800W	5	\$2029	\$2219
9100MB	9ms	7200	Seagate	ST19171W	5	\$2179	\$2369

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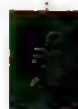
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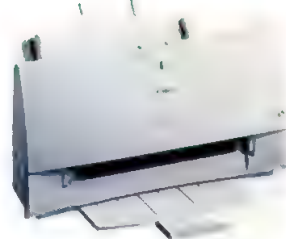
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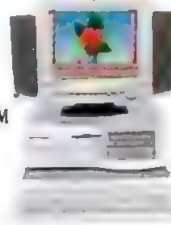
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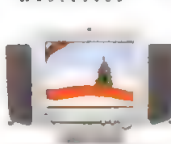
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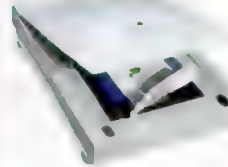
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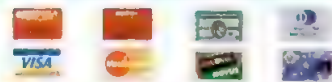
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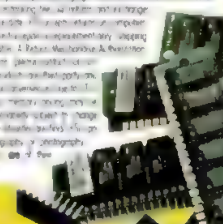
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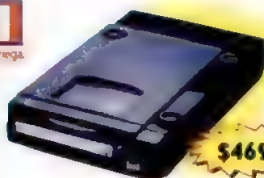
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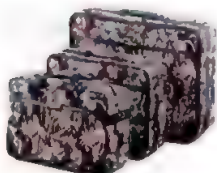


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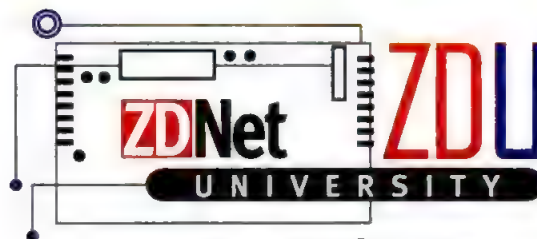
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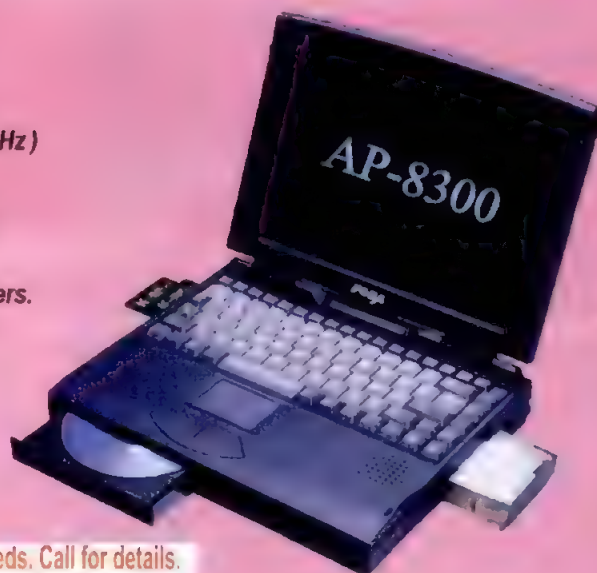
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2559MB	Caviar	12ms	128	5,200	16.6MB/sec	3.5" 1"H	Enhanced IDE	3 Year	WD32500AB	299.99
3166MB	Caviar	12ms	128	5,200	16.6MB/sec	3.5" 1"H	Enhanced IDE	3 Year	WD33100AB	379.99
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810MB	Marathon	16ms	120	4,500	16.6MB/sec	2.5" 19.15mm	Fast ATA-2	3 Year	ST9816AG	\$349.99
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2113MB	Medalist 2140	10ms	128	5,400	16.6MB/sec	3.5" 1.02"H	Fast-ATA-2	3 Year	ST32140AB	249.99
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1090MB	Winchester	12ms	64	4,500	16.6MB/sec	3.5" 1"H	Fast-ATA-2	3 Year	FJ1614AB	\$175.99
1280MB	Winchester	12ms	64	4,500	16.6MB/sec	3.5" 1"H	Fast-ATA-2	3 Year	FJ1636AB	199.99
1700MB	Winchester	12ms	64	4,500	16.6MB/sec	3.5" 1"H	Fast-ATA-2	3 Year	FJ1623AB	229.99
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2560MB	Winchester	12ms	64	4,500	16.6MB/sec	3.5" 1"H	Fast-ATA-2	3 Year	FJ1638AB	299.99
1708MB	Sirocco	11ms	128	4,500	16.6MB/sec	3.5" 1"H	Fast-ATA-2	3 Year	QUSR1708AB	\$225.99
2168MB	Fireball™	10.5ms	128	4,500	16.6MB/sec	3.5" 1"H	Fast-ATA-2	3 Year	QUTM2110AB	279.99
2550MB	Sirocco	11ms	128	4,500	16.6MB/sec	3.5" 1"H	Fast-ATA-2	3 Year	QUSR2550AB	319.99
3254MB	Fireball™	10.5ms	128	4,500	16.6MB/sec	3.5" 1"H	Fast-ATA-2	3 Year	QUTM3200AB	359.99
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2004MB	Durango	11ms	128	4,500	16.6MB/sec	3.5" 1"H	Enhanced IDE	3 Year	MX72004AB	285.99
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1050MB	Hawk 2XL	9ms	512	5,411	20MB/sec	3.5" 1"H	Ultra SCSI	3 Year	ST31055NB	349.99
1050MB	Hawk 2XL	9ms	512	5,411	40MB/sec	3.5" 1"H	Ultra Wide SCSI	3 Year	ST31055WB	389.99
2149MB	Hawk 2XL	9ms	512	5,400	20MB/sec	3.5" 1"H	Ultra SCSI	5 Year	ST32155NB	479.99
2149MB	Hawk 2XL	9ms	512	5,400	40MB/sec	3.5" 1"H	Ultra Wide SCSI	5 Year	ST32155WB	515.99
4294MB	Hawk 4	9ms	512	5,411	10MB/sec	3.5" HH	Fast SCSI-2 A/V	5 Year	ST15230NB	949.99
4294MB	Hawk 4	9ms	512	5,411	20MB/sec	3.5" HH	Fast Wide SCSI-2 A/V	5 Year	ST15230WB	989.99
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2147MB	Barracuda 2LP	8ms	512	7,200	10MB/sec	3.5" 1"H	Fast SCSI-2 A/V	5 Year	ST32550NB	\$749.99
2147MB	Barracuda 2LP	8ms	512	7,200	20MB/sec	3.5" 1"H	Fast Wide SCSI-2 A/V	5 Year	ST32550WB	799.99
2150MB	Barracuda 4LP	8ms	512	7,200	20MB/sec	3.5" 1"H	Ultra SCSI	5 Year	ST32171NB	749.99
2150MB	Barracuda 4LP	8ms	512	7,200	40MB/sec	3.5" 1"H	Ultra Wide SCSI	5 Year	ST32171WB	799.99
4294MB	Barracuda 4	8ms	1,024	7,200	10MB/sec	3.5" HH	Fast SCSI-2 A/V	5 Year	ST15150NB	1,049.99
4294MB	Barracuda 4	8ms	1,024	7,200	20MB/sec	3.5" HH	Fast Wide SCSI-2 A/V	5 Year	ST15150WB	1,099.99
4350MB	Barracuda 4LP	8ms	512	7,200	20MB/sec	3.5" 1"H	Ultra SCSI	5 Year	ST34371NB	1,149.99
4350MB	Barracuda 4LP	8ms	512	7,200	40MB/sec	3.5" 1"H	Ultra Wide SCSI	5 Year	ST34371WB	1,199.99
9090MB	Elite 9	11ms	1,024	5,400	10MB/sec	5.25" FH	Fast SCSI-2 A/V	5 Year	ST410800NB	1,999.99
9090MB	Elite 9	11ms	1,024	5,400	20MB/sec	5.25" FH	Fast Wide SCSI-2 A/V	5 Year	ST410800WB	2,049.99
9100MB	Barracuda 9	8ms	512	7,200	20MB/sec	3.5" HH	Ultra SCSI	5 Year	ST19171NB	2,099.99
9100MB	Barracuda 9	8ms	512	7,200	40MB/sec	3.5" HH	Ultra Wide SCSI	5 Year	ST19171WB	2,149.99
2170MB	Enterprise	8ms	512	7,200	20MB/sec	3.5" 1"H	Ultra SCSI	5 Year	WD2170SB	\$759.99
2170MB	Enterprise	8ms	512	7,200	40MB/sec	3.5" 1"H	Ultra Wide SCSI	5 Year	WD2170WB	799.99
4360MB	Enterprise	8ms	512	7,200	20MB/sec	3.5" 1"H	Ultra SCSI	5 Year	WD4360SB	1,129.99
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4360MB	Enterprise	8ms	512	7,200	40MB/sec	3.5" 1"H	Ultra Wide SCSI-3/SCA	5 Year	WD4360WC	1,199.99
2100MB	Aries	8.5ms	512	5,400	10MB/sec	3.5" 1"H	Fast SCSI-2	5 Year	MC4421SB	\$429.99
2100MB	Taurus	8.9ms	512	7,200	10MB/sec	3.5" 1"H	Fast SCSI-2	5 Year	MC4221SB	549.99
4300MB	Capricorn	8.5ms	512	7,200	10MB/sec	3.5" HH	Fast SCSI-2	5 Year	MC3243SB	859.99
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1280MB	Tempest	10.5ms	128	4,500	20MB/sec	3.5" 1"H	Ultra SCSI	3 Year	QUTM1280SB	\$319.99
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3200MB	Tempest	10.5ms	128	4,500	20MB/sec	3.5" 1"H	Ultra SCSI	3 Year	QUTM3200SB	499.99
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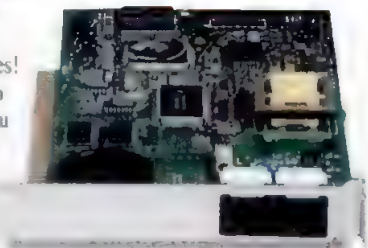
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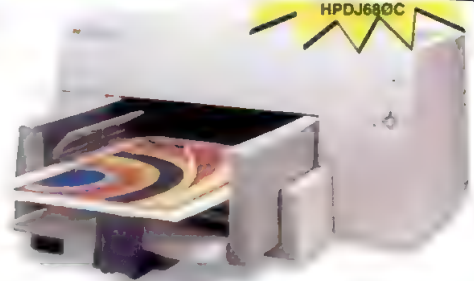
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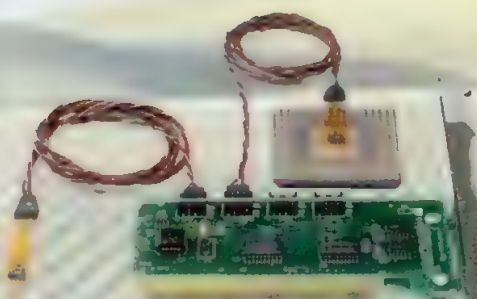
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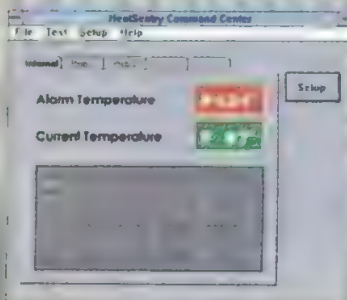
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Zenith (all models)	74	114	199	359
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70 Pin	883	94
404Meg	41	48
104Meg	88	89
304Meg	177	179

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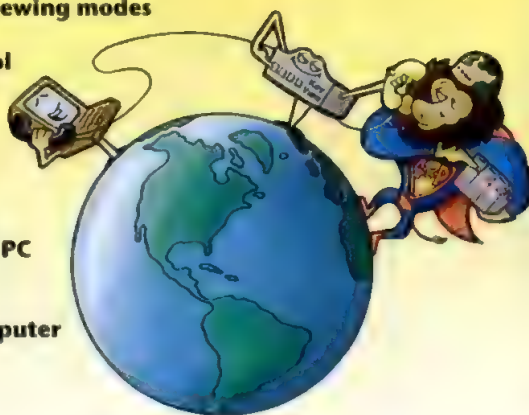
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4x4000 4x4000	54	94	188
4x4000 4x4000	39	64	178
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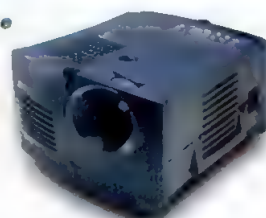
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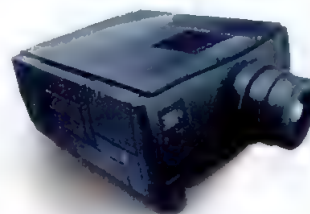
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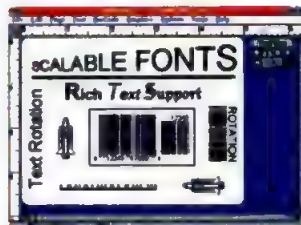
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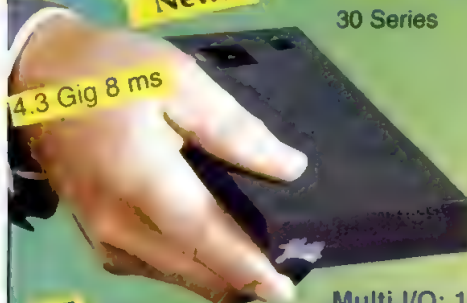
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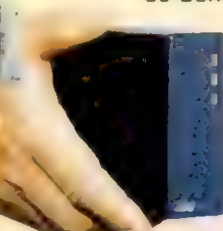


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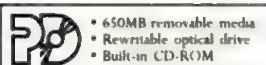
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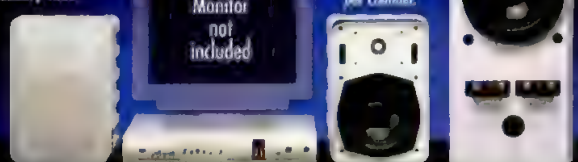
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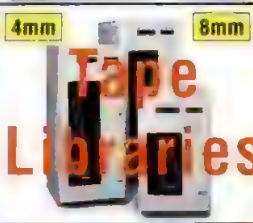
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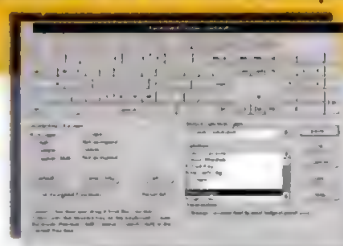


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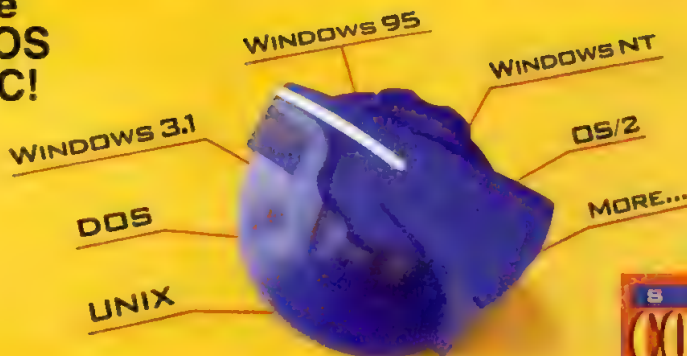
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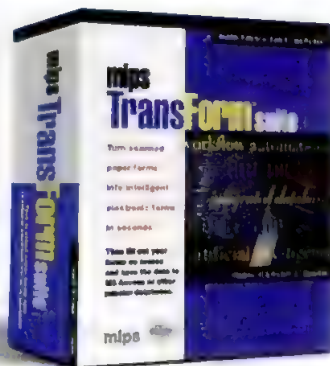
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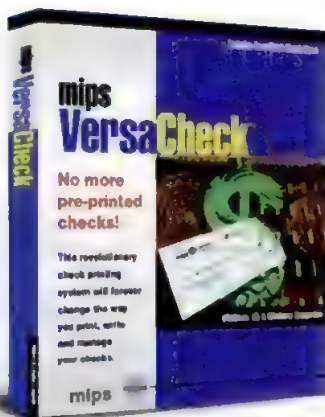
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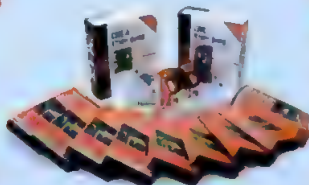
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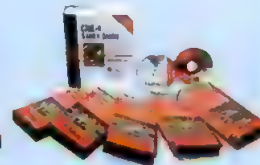
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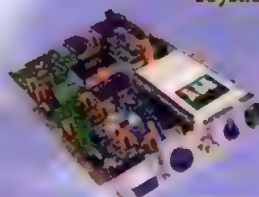
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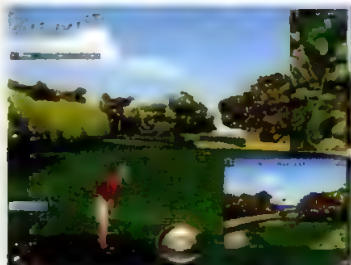


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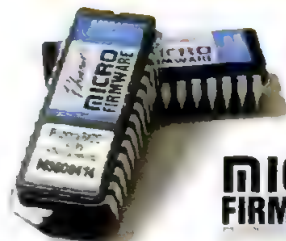
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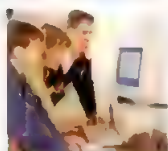
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100/120/133/150/166/183/200/213/233/250/266/283/300/333/350/366/383/400/433/450/466/483/500/533/550/566/583/600/633/650/666/683/700/733/750/766/783/800/833/850/866/883/900/933/950/966/983/1000/1033/1050/1066/1083/1100/1133/1150/1166/1183/1200/1233/1250/1266/1283/1300/1333/1350/1366/1383/1400/1433/1450/1466/1483/1500/1533/1550/1566/1583/1600/1633/1650/1666/1683/1700/1733/1750/1766/1783/1800/1833/1850/1866/1883/1900/1933/1950/1966/1983/2000/2033/2050/2066/2083/2100/2133/2150/2166/2183/2200/2233/2250/2266/2283/2300/2333/2350/2366/2383/2400/2433/2450/2466/2483/2500/2533/2550/2566/2583/2600/2633/2650/2666/2683/2700/2733/2750/2766/2783/2800/2833/2850/2866/2883/2900/2933/2950/2966/2983/3000/3033/3050/3066/3083/3100/3133/3150/3166/3183/3200/3233/3250/3266/3283/3300/3333/3350/3366/3383/3400/3433/3450/3466/3483/3500/3533/3550/3566/3583/3600/3633/3650/3666/3683/3700/3733/3750/3766/3783/3800/3833/3850/3866/3883/3900/3933/3950/3966/3983/4000/4033/4050/4066/4083/4100/4133/4150/4166/4183/4200/4233/4250/4266/4283/4300/4333/4350/4366/4383/4400/4433/4450/4466/4483/4500/4533/4550/4566/4583/4600/4633/4650/4666/4683/4700/4733/4750/4766/4783/4800/4833/4850/4866/4883/4900/4933/4950/4966/4983/5000/5033/5050/5066/5083/5100/5133/5150/5166/5183/5200/5233/5250/5266/5283/5300/5333/5350/5366/5383/5400/5433/5450/5466/5483/5500/5533/5550/5566/5583/5600/5633/5650/5666/5683/5700/5733/5750/5766/5783/5800/5833/5850/5866/5883/5900/5933/5950/5966/5983/6000/6033/6050/6066/6083/6100/6133/6150/6166/6183/6200/6233/6250/6266/6283/6300/6333/6350/6366/6383/6400/6433/6450/6466/6483/6500/6533/6550/6566/6583/6600/6633/6650/6666/6683/6700/6733/6750/6766/6783/6800/6833/6850/6866/6883/6900/6933/6950/6966/6983/7000/7033/7050/7066/7083/7100/7133/7150/7166/7183/7200/7233/7250/7266/7283/7300/7333/7350/7366/7383/7400/7433/7450/7466/7483/7500/7533/7550/7566/7583/7600/7633/7650/7666/7683/7700/7733/7750/7766/7783/7800/7833/7850/7866/7883/7900/7933/7950/7966/7983/8000/8033/8050/8066/8083/8100/8133/8150/8166/8183/8200/8233/8250/8266/8283/8300/8333/8350/8366/8383/8400/8433/8450/8466/8483/8500/8533/8550/8566/8583/8600/8633/8650/8666/8683/8700/8733/8750/8766/8783/8800/8833/8850/8866/8883/8900/8933/8950/8966/8983/9000/9033/9050/9066/9083/9100/9133/9150/9166/9183/9200/9233/9250/9266/9283/9300/9333/9350/9366/9383/9400/9433/9450/9466/9483/9500/9533/9550/9566/9583/9600/9633/9650/9666/9683/9700/9733/9750/9766/9783/9800/9833/9850/9866/9883/9900/9933/9950/9966/9983/10000/10033/10050/10066/10083/10100/10133/10150/10166/10183/10200/10233/10250/10266/10283/10300/10333/10350/10366/10383/10400/10433/10450/10466/10483/10500/10533/10550/10566/10583/10600/10633/10650/10666/10683/10700/10733/10750/10766/10783/10800/10833/10850/10866/10883/10900/10933/10950/10966/10983/11000/11033/11050/11066/11083/11100/11133/11150/11166/11183/11200/11233/11250/11266/11283/11300/11333/11350/11366/11383/11400/11433/11450/11466/11483/11500/11533/11550/11566/11583/11600/11633/11650/11666/11683/11700/11733/11750/11766/11783/11800/11833/11850/11866/11883/11900/11933/11950/11966/11983/12000/12033/12050/12066/12083/12100/12133/12150/12166/12183/12200/12233/12250/12266/12283/12300/12333/12350/12366/12383/12400/12433/12450/12466/12483/12500/12533/12550/12566/12583/12600/12633/12650/12666/12683/12700/12733/12750/12766/12783/12800/12833/12850/12866/12883/12900/12933/12950/12966/12983/13000/13033/13050/13066/13083/13100/13133/13150/13166/13183/13200/13233/13250/13266/13283/13300/13333/13350/13366/13383/13400/13433/13450/13466/13483/13500/13533/13550/13566/13583/13600/13633/13650/13666/13683/13700/13733/13750/13766/13783/13800/13833/13850/13866/13883/13900/13933/13950/13966/13983/14000/14033/14050/14066/14083/14100/14133/14150/14166/14183/14200/14233/14250/14266/14283/14300/14333/14350/14366/14383/14400/14433/14450/14466/14483/14500/14533/14550/14566/14583/14600/14633/14650/14666/14683/14700/14733/14750/14766/14783/14800/14833/14850/14866/14883/14900/14933/14950/14966/14983/15000/15033/15050/15066/15083/15100/15133/15150/15166/15183/15200/15233/15250/15266/15283/15300/15333/15350/15366/15383/15400/15433/15450/15466/15483/15500/15533/15550/15566/15583/15600/15633/15650/15666/15683/15700/15733/15750/15766/15783/15800/15833/15850/15866/15883/15900/15933/15950/15966/15983/16000/16033/16050/16066/16083/16100/16133/16150/16166/16183/16200/16233/16250/16266/16283/16300/16333/16350/16366/16383/16400/16433/16450/16466/16483/16500/16533/16550/16566/16583/16600/16633/16650/16666/16683/16700/16733/16750/16766/16783/16800/16833/16850/16866/16883/16900/16933/16950/16966/16983/17000/17033/17050/17066/17083/17100/17133/17150/17166/17183/17200/17233/17250/17266/17283/17300/17333/17350/17366/17383/17400/17433/17450/17466/17483/17500/17533/17550/17566/17583/17600/17633/17650/17666/17683/17700/17733/17750/17766/17783/17800/17833/17850/17866/17883/17900/17933/17950/17966/17983/18000/18033/18050/18066/18083/18100/18133/18150/18166/18183/18200/18233/18250/18266/18283/18300/18333/18350/18366/18383/18400/18433/18450/18466/18483/18500/18533/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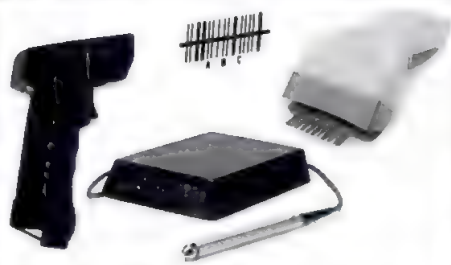
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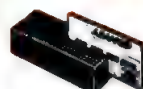
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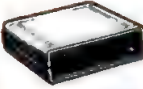
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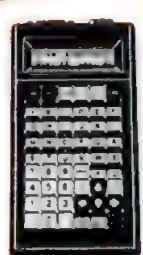
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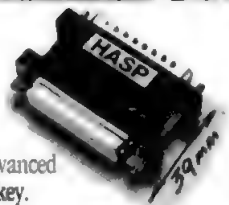
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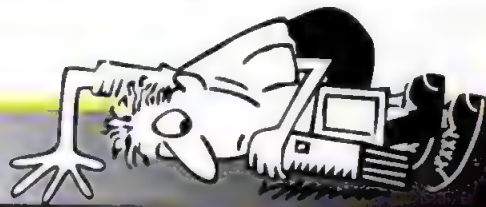
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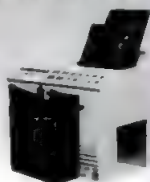
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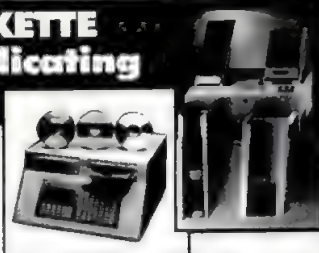
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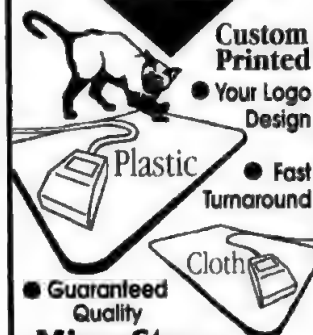
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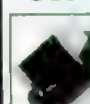
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Honor was all fine and good in MechWarrior 2, but the almighty dollar rules in Activision's latest 'Mech game.

MechWarrior 2: Mercenaries

The original MechWarrior 2 and its expansion pack, Ghost Bear's Legacy, are great games. Few have had such an impact on the gaming community. So when this level of success is followed up with a full-fledged sequel (or prequel to the original, in this case), there's always the risk that the new title will not live up to its predecessors' reputation. This is not a problem with MechWarrior 2: Mercenaries.

Like the original MechWarrior 2 games (based on FASA's

fled the Inner Sphere hundreds of years ago because of political infighting, returned with superior technology and a new social order to reclaim their ancestors' homeland.)

Mercenaries casts you on the opposite side. You, a warrior for hire who works for the highest bidder, are now in the Inner Sphere before the Clan warriors' return. This difference has a huge impact on the flow of the game. In MechWarrior 2, you could start each mission with fresh, undamaged equipment from the Clan military stores. But in

Mercenaries, you *own* your 'Mech. If you want that 100-ton customized Atlas, you have to buy it (though a rookie mode allows 'Mech selection and game play similar to that of MechWarrior 2). Resource management adds a whole new dimension to an already strong game:

Repairs and ammunition now cost money. And if you don't want to fight alone, you must hire some comrades and keep them supplied.

Technology improves as the game rolls along. The last third of the game puts you in the

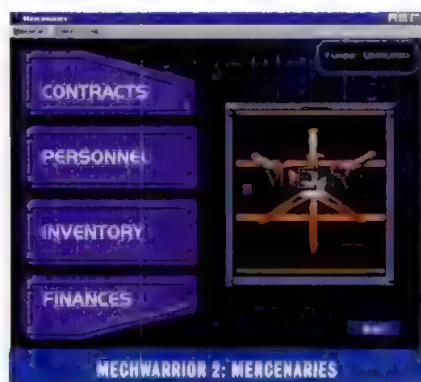


path of the Clan invasion, fighting against the 'Mechs you loved in MechWarrior 2 games. True to the BattleTech story, the Clan 'Mechs are much more powerful than yours. Constrained by honor, they engage your forces one on one, while your forces can—and should—gang up on their enemies. You can even hire air support to rain down fire on the battlefield.

In Mercenaries, the MechWarrior 2 game engine has been given a major face-lift. Even though it lacks some of the sky and shading effects you may have seen in 3-D accelerated versions of MechWarrior 2 (such as the one bundled with ATI's 3D Xpression graphics card), Mercenaries has complete

ground and object textures, shadows, light sourcing, and other spectacular effects. You can run Mercs at resolutions up to 1,024-by-768, although even on a Pentium/133 you'll need to turn off some of the detail options in order to get the game running smoothly. On a Pentium/90 or /100, you're stuck with 320-by-200.

Finally, Mercenaries includes support for Activision's MercNet, a free Internet gaming system for online Mercenaries matches. With its new resource management requirements, its cutthroat attitude, and its free online hooks, MechWarrior 2: Mercenaries is the most complete, fun and addictive game in the MechWarrior series. —Bernard H. Yee



BattleTech board game universe), Mercenaries puts you in the cockpit of a hulking, three-story BattleMech—a walking robot armed to the teeth. In MechWarrior 2, you played on the Clan side. (Clan warriors, descended from an army that

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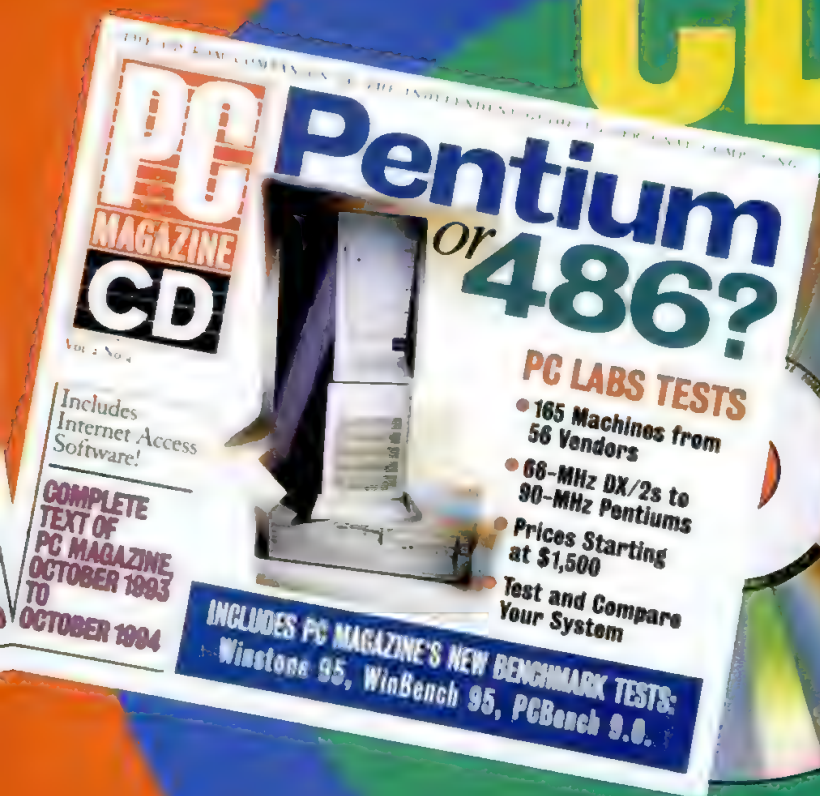


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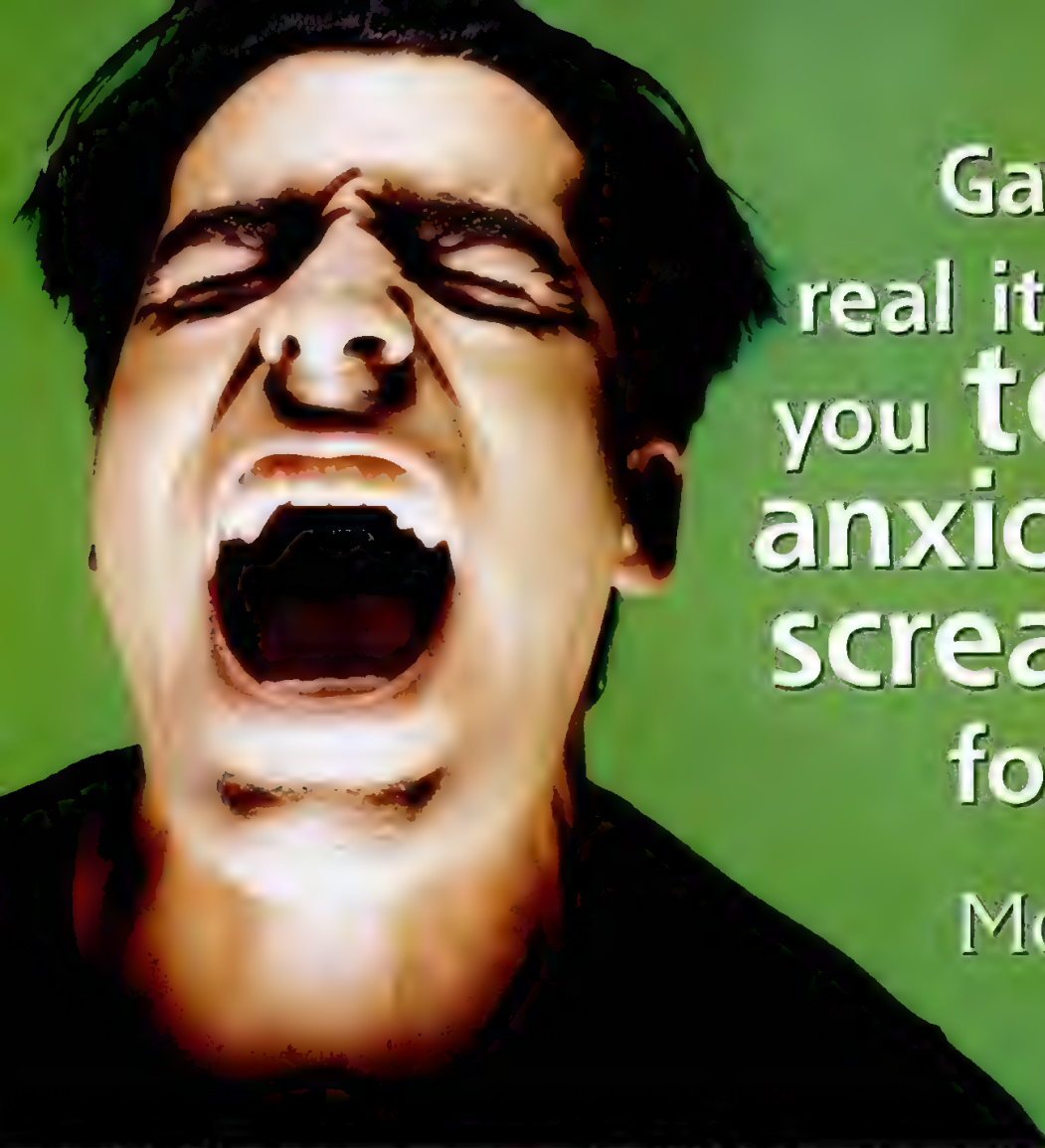
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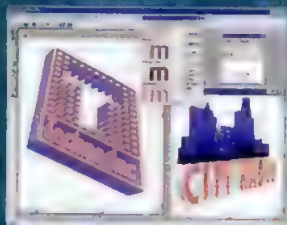
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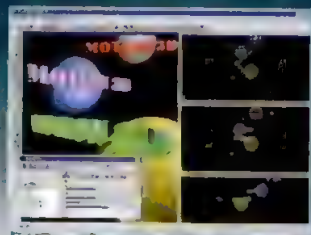
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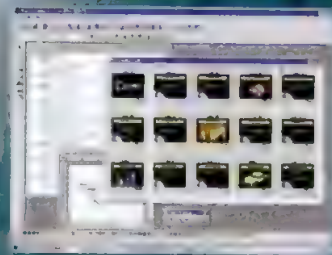


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The Only Game in Town?

For years, Electronic Arts' sports titles have set the mark for all other sports games to match. This year, the tradition continues.

Madden NFL 97

John Madden: famous football coach, television commentator, and star of those great Miller Lite commercials from the early 1980s. But among gamers, he is best known for the line of football games that bears his name. For the past three years, these games have been available only on console gaming systems such as the Sony PlayStation. Finally, the series makes a triumphant return to the PC in Madden NFL 97.

University, a multimedia football tutorial that could actually stand (and sell) on its own.

Exhibition play lets you set up a single game between any of Madden 97's 100 teams, which include all 30 current rosters plus past Super Bowl champions and other all-time-great squads. Modern and network play gives you the option of playing a friend over a direct, modem, or IPX network link.

But the meat of Madden 97 is in the league play. Here, you can guide a team through a



This two-CD DOS game offers a solid combination of action, strategy, and statistics. It should satisfy any PC-toting football fan.

You can play it in three different modes: exhibition game, league play, modem and network play. You can also take a spin through Madden

complete 16-game schedule and the playoffs. You can follow the 1996-1997 NFL schedule or create one of your own.

The game play is fairly simplistic but can be tough to master on the highest difficulty setting (there are three). Passing is easy, and you'll most likely come to rely on it as your main



weapon, because rushing is a tremendous challenge. This is compounded by the fact that the computer *always* seems to know when you're going to run. (We reached the 100-yard mark only once all season with Seattle All-Pro Chris Warren but managed to get Rick Mirer over 50 touchdown passes.) Playing defense is tough as well, but going after those quarterback sacks is so much fun.

Madden NFL 97 tracks all the important statistics, although we would have liked to see a few more. We initially enjoyed John Madden and his real-life colleague Pat Summerall's play-by-play but soon disabled it as it grew annoyingly monotonous.

But these are minor points. Madden NFL 97 is one of the best football games on the market—and by far the most fun to play.—*Michael E. Ryan*

NHL 97

Even though hockey ranks a distant fourth among the most popular spectator sports in America, it has long been a favorite of PC gamers, thanks in large part to the continuing excellence of Electron-

ic Arts' NHL hockey games. And as good as past versions of the game have been, NHL 97 skates rings around them.

NHL 97, a CD-ROM game that runs on both DOS and Windows 95, is simply the best hockey game we've ever seen and possibly the best sports game, period.

Realistic

action, extensive statistics, and eye-popping, breakthrough graphics highlight this impressive title.

The game uses 3-D, polygonal players that move and behave very much like real NHL players. They even *look* like real players: NHL players' photos have been texture-mapped onto their virtual faces. We could easily recognize players such as Doug Gilmour and Claude Lemieux, among others. Also, 30 real goaltenders' masks are "worn" by the goalies in the game.

You can play the game in exhibition or league mode, against either the computer or another player. The game play, which has been solid in previ-

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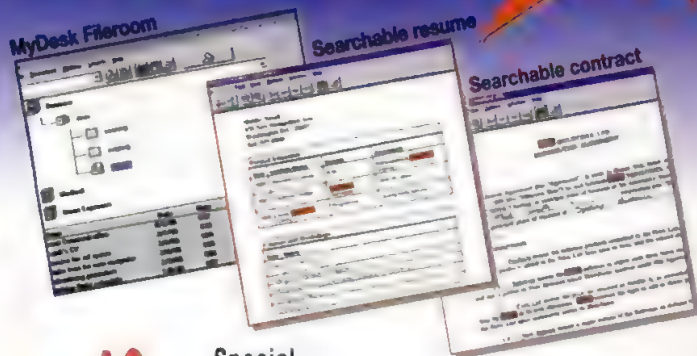
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After Hours



ous versions, is even better this time around. Each game unfolds in realistic fashion. Where previous versions of the game seemed to limit players to one or two guaranteed (and highly unrealistic) scoring methods, we scored most of our goals in NHL 97 off rebounds (just as they do in the real NHL). Of course, you'll still get plenty of breakaways and one-timers, but you'll find the computer-controlled goalies tough to beat even on those opportunities.

It takes some practice to get the hang of the new polygonal players, and—if you're like us—you'll find it's pretty hard to get out of the way of a charging Eric Lindros. But trust us, a little practice goes a long way.

Between games, you have tons of management options, including computer-arbitrated trades and a reassignment feature that essentially lets you send players to the minors.

You can also take a look at a wealth of statistics tracked by the game, including goals, assists, penalty minutes, and hits, as well as goals and assists scored by goalies.

NHL 97 is so strong a game that finding anything to criticize is hard: It even ran well on our somewhat dated Pentium/90. Hockey fans will love this game, and we think it will spawn a few new hockey fans as well.—MER

QUICK CLIPS



Baku Baku

Wow, is this funky Tetris-style game addictive! Load it up with a friend on the Internet or an IPX network and kill twice as much time (and productivity)! \$34.95 list; Sega Entertainment, 415-508-2800.



Crusader: No Regret

Ten new levels, 19 weapons, and 21 cool moves make this sequel to Crusader: No Remorse a winner. But if Origin makes another sequel, what "R" word is left? Repentance? \$50 street; Origin Systems, 800-245-4525.



Z

Imagine Command & Conquer with more attitude and a horde of wisecracking, drunken robots. Lots of fun and very challenging, especially over an IPX network. \$40 street; Virgin Interactive Entertainment, 800-874-4607.



NFL Quarterback Club '97

This one probably looks and plays fine on the console systems, but it comes up limping on the PC. Not even in the same league as Madden NFL 97. \$50 street; Acclaim Entertainment Inc., 516-759-7800.



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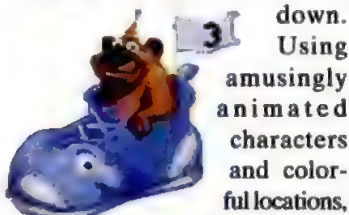
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Fun with Numbers

It's time to learn a little math, with help from otters, bubbles, and bears (oh my!) in Edmark's latest title.

Mighty Math Carnival Countdown

Think back to your second-grade math class. Was long division a form of torture? Did you ever figure out what the > symbol meant? Edmark wants your child to be free of such trauma, so it released Mighty Math Carnival Countdown.



Using amusingly animated characters and colorful locations, Carnival Countdown is full of fun math games.

There are five sideshow locations you can pick from. Each has two modes: question-and-answer and explore. In question-and-answer mode, animal guides ask children to complete a specific set of tasks and offer clues where needed. Explore mode lets kids design their own math problems.

Each section is lively and funny, as well as educational. For example, the Carnival Cars section asks kids to sort cars by color, driver, car style, number, and horn sound. Snap Clowns, on the other hand, teaches addition and subtraction by asking you to attach clowns to circus poles. An animated mouth (which looks like the Rolling Stones logo) will speak the addition or subtraction problem aloud when you click on it.

Our favorite section was the Giggle Factory, where the Otter Twins help children un-

derstand the greater than, less than, and equals signs. A bubble in between two scales displays one of the signs, and your child must use spigots to dispense giggles in denominations of ones, tens, and hundreds onto the scales. At higher levels, kids have to

choose the math problem whose result makes the sign in the middle true.

Math doesn't have to be scary, and Mighty Math Carnival Countdown is a good, fun way to introduce children (aged 5 to 8) to concepts they'll use for the rest of their lives. It is not quite on a par with Davidson's Mega Math Blaster in terms of content or design, but it makes



a solid addition (no pun intended) to any educational collection.—*Mary E. Behr*

The Mercs Are Back

Sir-Tech adds multiplayer capabilities to its strategy role-playing adventure.

Jagged Alliance: Deadly Games

The original Jagged Alliance introduced us to the fascinating life of a mercenary; 60 of them, in fact, any of which you could hire to join an elite band of guns in your covert operations. Now the same 60 are back, along with 10 more and a host of new features that make Jagged Alliance: Deadly Games surprisingly superior to its predecessor, proving that even the best products can be improved.

You manage a team of mercenaries on 30 or more missions whose goals range from taking pictures of an enemy installation to blowing it up. From a top-down perspective, you guide your team one by one through the environment of

this turn-based game, keeping them hidden from enemy fire using trees and other cover.

But this is more than just a war game; it's also a role-playing game. There are over 6,000 lines of digitized dialog to accentuate the unique personality of each and every mercenary. Some are certi-



able psychos like Fidel, who'll stand in the open, blazing away until the enemy is thoroughly and completely dead, while others, like Ivan (our favorite), are cold, calculating

professionals. Some of our regular hires included Scope, Buzz, and Needle. Each mercenary has a unique set of attributes in a variety of areas, including agility, medical skill, and explosives. You can even improve these through experience and training.

The most notable new feature in Deadly Games is multiplayer support. Not only has Sir-Tech added this capability, allowing a maximum of four players on an IPX network or over Total Entertainment Network (TEN), but it also includes a special multiplayer CD with the game, so your friends (or enemies) don't all have to buy copies in order to play you.

If that's not enough, there's also an intuitive scenario editor in which you can create single missions or entire campaigns, controlling the terrain and placement of enemies, objects, and objectives.

Our only complaints are minor: a soundtrack that was recycled from the original game and less-than-stellar graphics. But these are easily overshadowed by the game's excellent design and addictive nature.—*Shane Mooney*

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The 1996 Technical Excellence Awards

For the thirteenth year running, *PC Magazine* editors pick the year's most significant and innovative technologies in hardware and software. These are the products and standards that will shape the course of computing in the coming year and beyond.

Home PCs

If you're thinking of buying yourself or your family a PC as a present this holiday season, this is the issue to consult. *PC Magazine* tests 18 of the hottest new home PCs and tells you all the essentials: what peripherals they come with, the quality of the software bundles, and, of course, how well they perform on our benchmark tests.

Holiday Gift Guide

The holidays are nearly here, so it must be time for *PC Magazine*'s third annual Holiday Gift Guide. This year, we preview 101 products that are scheduled to ship during November and December, including more than 50 games, 25 kids' titles, and a handful of cool gadgets.



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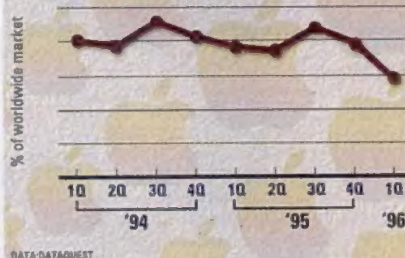
THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

On Fiji, They Look at Things A Little Differently

"With a megabyte of 686 P120, the system can be upgraded as the years pass, its memory verified with a customised programming in response to its application, and its CPU (Central Planning Unit) can also be improved."—*Fiji's DAILY POST*

Apple's Sliding PC Market Share

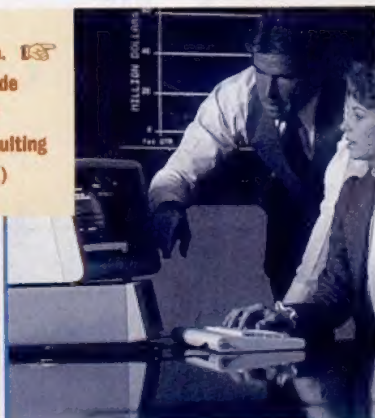


Well, You Should Trim the Cables with Scissors, Too

"Question: I think I got a bad deal with my fax/modem card. It wouldn't fit the slot in my PC, so I filed it down, but it still didn't work. Should I be concerned that I may have damaged the card?"—*PC BUYER'S GUIDE*

Yeah, times change. What say we upgrade that PC from 1982? (Management Consulting Services brochure.)

TIMES CHANGE... WILL YOU CHANGE WITH THEM?



Things On The Net Newt Wouldn't Want You To See

By B. Ballsey
and the editors of Off Color Press

ARF recommends this funny, \$8.95 book. The cartoons of Newt are hilarious. (Off Color Press; ISBN: 1-887652-28-0.)

More Good Advice to Help Novices Understand Computers

"Tips for safer drives: Never turn off a PC or accessories while the computer is on or the disk is active."—*USA TODAY*



"What is it Lassie? Is it Gramps? Is it his hard disk? Is he stuck somewhere, girl? Is he trying to write CGI programs to a Unix server running VRML? What, girl, what?!"

RICHARD TENNANT

If your entry is used, we'll send you \$50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802 or, via e-mail (text items only), to don_willmott@zd.com. Winners this issue: Gabriel Accascina, Howard Barker, John Billman, M.T. Buxton.

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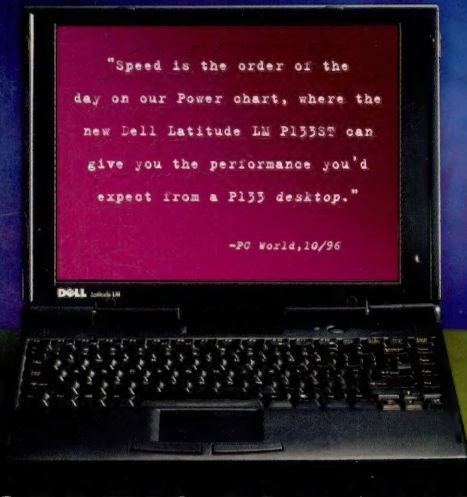
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